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MODEL AIRPLANE NEWS

48120 July 1993

THE WORLD'S PREMIER R/C MODELING MAGAZINE

2.95 CANADA $3.75

Robart's New Scale Radial!

educing Engine Noise • Tumbling-Wing Rotorplane! • GP Ultra-Sport 1000

MODEL AIRPLANE NEWS

FEATURES

ABOVE: *the new Robart radial engine is run up briefly at the Toledo show. Frank Knoll (left) and Dennis Crooks (center) hold the engine mount firmly as the engine is briefly throttled up. Mike Hanlan (right)— Robart's machine shop foreman—looks on proudly. See cover story. (Photo by Tom Atwood.)*

ON THE COVER: *here's a close-up of the front of Robart's new, scale Jacobs engine. (Photo by Walter Sidas.)*

FEATURES

CONSTRUCTION

COLUMNS

COLUMNS

COLUMNS

DEPARTMENTS

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EDITORIAL

TOM ATWOOD

SOMETHING NEW UNDER THE SUN

The photo shows a new UAV model that may be of interest to those who are particularly fascinated by design. It was developed by Burt Rutan and Freewing Aircraft Corp. The Scorpion is a 40-percent-scale, proof-of-concept model of a remotely piloted vehicle to be entered in the Defense Department's "Close-Range Unmanned Vehicle Competition" in July this year. The UAV to be entered—itself a *super* R/C model—must meet astonishing requirements. It will weigh 200 pounds (gross), which includes a 50-pound payload. The "radius of action" (range) will be 50 kilometers. It must be able to achieve 150 knots in a dash, cruise at 100 knots, stay aloft for three hours and have a service ceiling of 10,000 feet. It must also be able to achieve a rolling launch and recovery within a 30x75-meter clearing that is surrounded by a 10-meter wall.

One of the design's secrets is thrust vectoring—the body's nose can be pivoted upward relative to the tail boom (to a limit of 90 degrees above the horizon). This allows the prop wash to be directed downward, and this, in turn, permits the plane to fly at 20 percent of stall speed. Thrust vectoring allows takeoff and recovery in tight confines that would otherwise require a catapault-and-net system.

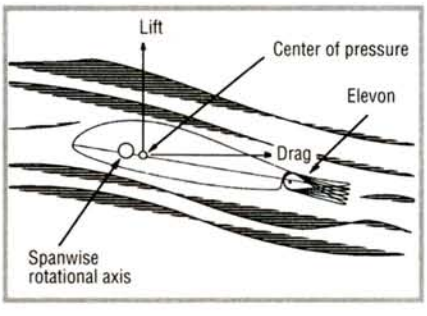
The Scorpion—a proof-of-concept model developed by Burt Rutan and Freewing Aircraft—climbs out. The photo shows the main wing and the tail booms angled in the same plane, both pointing into the relative wind.

THE FREEWING

Perhaps even more remarkable than the rotating body is the "freewing." The main wing is mounted on pivots that are oriented spanwise along the wing's CG. This permits the wing to swing or pivot in the pitch axis, independent of the tail booms and fuselage body. The wing's reflexed airfoil keeps it aerodynamically in trim; the wing constantly adjusts to point directly into the relative wind. When flying through turbulence, the wing's leading edge reacts by momentarily rocking upward or downward, i.e., with the trailing edge moving in the opposite direction. Any turbulence-induced wing rocking is almost immediately damped.

The freewing's action reduces by as much as 90 percent the airplane's vertical displacement when it's hit by sudden gusts, e.g., the airframe would bounce up 5 inches instead of 50 inches. This is possible because when a gust hits the wing, the wing rocks and absorbs most of the energy instead of sending it to the airframe. The result is a steadier, shorter, more efficient flight path.

This design is another example of high technology springing from the modeler's workbench. The 6-foot-span, 11-pound Scorpion is powered by a Super Tigre .90 spinning a 13x6 APC prop. Byron 15 percent fuel has been used on test flights. The wing loading is a hefty 50 ounces per square foot. The heavy wing loading underscores the payload-carrying capacity of the design and raises the top-end speed. In a conventional airplane, a heavy wing loading would also bring up the landing speed, but the Scorpion's thrust vectoring minimizes both approach speed and takeoff speed. Wind-tunnel tests with a similarly configured model have demonstrated a minimal level flight speed of around 20mph. Contrast this with the Scorpion's top speed of around 100mph.



The model's construction is familiar. It has fiberglass-covered (vacu-bagged) foam-core wings that have a few ply ribs at critical points. The body is of fiberglass, monocoque construction (the body was laid up over foam, which was later dissolved out). The tail feathers are MonoKote-covered balsa. An ACE Micropro 8,000 radio controls the plane. Five standard servos and one full-scale, linear-output aircraft trim servo are used; this servo controls the angle between the tail boom and the body and exerts 40 pounds of thrust over one inch.

Freewing technology is currently being applied to manned aircraft such as Freewing Aircraft's two-place Freebird MK-5. But I have to wonder, also, what this design advance can mean for modelers. Many a modeler has been temporarily grounded by gusty conditions! How new is the freewing concept? George Spratt, a pioneer of similar pivoting wing technology, has pointed out that it is, in fact, quite old. His father—a contemporary of the Wright brothers—suggested that they try the concept. George further points out that birds have been applying their own version of this design for tens of millions of years. Modelers who would like to know more should contact Freewing Aircraft Corp., Bldg. 340, University of Maryland, College Park, MD 20742.

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AIRWAVES

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," **Model Airplane News,** 251 Danbury Road, Wilton, CT 06897. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we cannot respond to every one.

TURBINE JET FUELS

The whine and rush of a true jet is virtually guaranteed to attract thousands of new enthusiasts to the model flying fold and to produce a quantum leap in the public image of R/C flying. The new turbojets also present a hazard that has been relatively insignificant with piston-engine models—fire.

Some of the first experimental turbojets of the late '30s burned gaseous fuel. Such fuel was considered impractical for an airplane because of the risk of fire and explosion and the need for large, heavy fuel tanks. The early experimenters quickly learned how to make the engines run on liquid fuels such as kerosene, and aviation took a giant leap. Light, portable, gas-turbine electrical generating sets made by KHD Deutz in Germany and Kawasaki in Japan have amply demonstrated their ability to start and run well on relatively non-flammable kerosene. Small turbojets have a fairly low fuel efficiency and must carry a significant amount of fuel. A crash into a parked car that ruptured a propane fuel tank could result in disaster. The red-hot turbine section is only too ready to provide ignition. There is, of course, no absolutely safe fuel. Even mild-mannered fuel may occasionally indulge in incendiary behavior.

Apart from concern about safety, methanol—the basic ingredient in model-engine "flow" fuel—is an excellent, high-octane fuel for racing engines. Its high latent heat of evaporation helps cool the incoming charge and increase its density, producing a supercharging effect while helping to cool a highly stressed engine. This same property makes it harder to burn in a gas turbine, where it must be vaporized very quickly by combustion-chamber heat. It also liberates less than half the energy per unit volume of gasoline or kerosene, and this necessitates more frequent fuel stops.

Although it burns more cleanly, propane presents an even greater fire hazard than gasoline. At atmospheric pressure, it can exist as a liquid only at temperatures of less than 51 degrees below zero Fahrenheit. If a propane tank ruptures, its high vapor pressure will rapidly discharge most of the contents. The spilled liquid part will rapidly pick up heat from its surroundings, vaporize and mix with air to form a large volume of highly flammable or even explosive gas. I understand that the AMA wisely imposes carefully measured restrictions on model turbojet flying. I suggest that propane or other gas-fuel models be regarded as somewhat experimental and limited to flying only in a very closely controlled environment, and that the use of kerosene, or its equivalent, Jet A, be strongly encouraged.

Still in their early infancy, model turbojets are at about the same state of development as model piston engines were in, say, 1930. As time passes, vast improvements in performance and cost will be inevitable. Tiny gas turbines have been proven to start and run quite well on kerosene by using a simple vaporizing combustion chamber and a high-energy ignition system. Kerosene packs over twice the energy of propane per unit volume. The fuel tank need not be a heavy-pressure vessel, and it can be conveniently shaped to fit a model's interior. In a few years, far more fuel-efficient, quiet turbofans and even model turboprops may be technically and economically feasible. Light composite compressors and all-ceramic turbine sections that will increase thrust-to-weight ratios are just around the corner. It would be a terrible loss to all of us if one or two accidents brought down the curtain on such a vista.

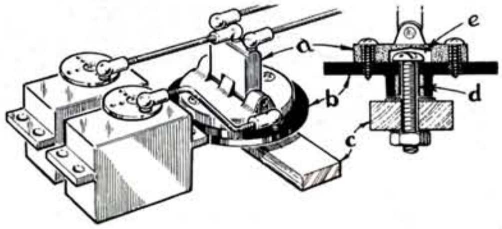
CARL RISTEEN
New Brunswick, Canada

This is an excerpt from a letter that was sent to Bob Underwood, AMA technical director and "copied" to Model Airplane News. Our thanks to Carl for setting out the safety issues so clearly. See this issue's "Air Scoop" for a peek at a new kerosene-burning turbine made in Sweden. TA

HINTS & KINKS

JIM NEWMAN

Model Airplane News will give a free one-year subscription (or one-year renewal if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o Model Airplane News, 251 Danbury Rd., Wilton, Ct 06897. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO, AND NOTE YOU SUBMIT. Because of the number of ideas we receive,we can't acknowledge each one, nor can we return unused material.



LOW-PROFILE MIXER SYSTEM

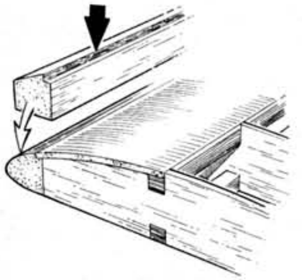
A mixer of this type (a) usually sits on top of the rudder servo wheel, but it's difficult to do this on a low-profile fuselage. Instead, attach the mixer to a spare servo wheel (b) that can then be mounted on a hardwood cross-member lower in the fuselage (c). Notice how the servo wheel has been drilled out and bushed with brass tube (d) that has been epoxied into place. You'll have to recess the bottom of the mixer (e) to ensure that it clears the screw head.

Mike Redfield, Vista, CA

FUELPROOF TANK BAY

Cut the top off a soft-drink can and epoxy it through the firewall as shown here. Wrap your fuel tank in foam rubber (not too tight, or fuel foaming will result), and then insert the tank into the can. If the fuel leaks, the can will prevent it from spilling into the fuselage. This setup also allows easy access to the tank when the cowl has been removed. Be sure that the tank's center is within 3/8 inch (9mm) of the spraybar center line.

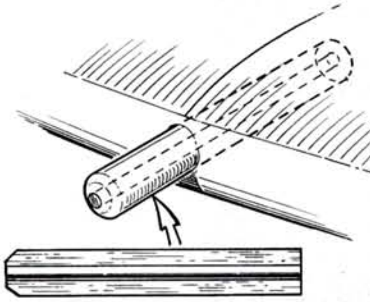
Claudio R/C Capitani, Bacacheri, Curitiba, Brazil



BETTER LEADING-EDGE SHEETING JOINT

Run your leading-edge stock through a table saw to make a groove like the one shown by the arrow. This provides a ledge for the leading-edge sheeting that allows more precise alignment and a superior joint. It's also easier to sand. If you don't have a table saw, you can glue a strip to the rear of the leading edge. To compensate for the added strip, though, trim a little off the rib front.

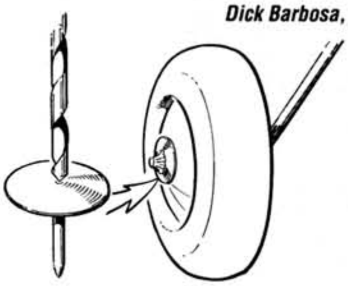
Dennis Bryant, Burgess Hill, Sussex, England



LEADING-EDGE DOWEL REINFORCEMENT

On a lathe, drill out the middle of a wooden, leading-edge dowel, and then glue a piece of 1/16-inch (1.5mm) or 5/64-inch (2mm) music wire inside it. This strengthens the dowel, and even if it breaks, the wire will hold the pieces together and allow a safe, "precautionary" landing.

Dick Barbosa, Pottsboro, TX



LARGE CUP WASHERS

Using a drill bit that has the same diameter as your landing-gear wire, drill through the top of a brass-plated thumbtack to remove the pin. You'll be left with a large cup washer that's ideal for retaining your plane's wheels. To provide running clearance and heat insulation for the wheel, insert a postcard shim behind each washer before you solder it into place. To ensure that your wheels turn smoothly, solder a washer onto the inboard side of each gear, too.

Levent Suberk, Bursa, Turkey

FREE MUSIC WIRE

Whenever some inconsiderate soul dumps a mattress in a roadside ditch or a hedgerow, you can do the community a favor by taking it to the landfill. But before you dump it, use bolt cutters to cut the perimeter wire (shown at the Xs), and then pull out the straight pieces. It's high-quality 3/16-inch (5mm) music wire; it's free; and it's ideal for landing gears and wing wires. You'll also be helping the environment!

Danny Littlejohn, Corinth, MS

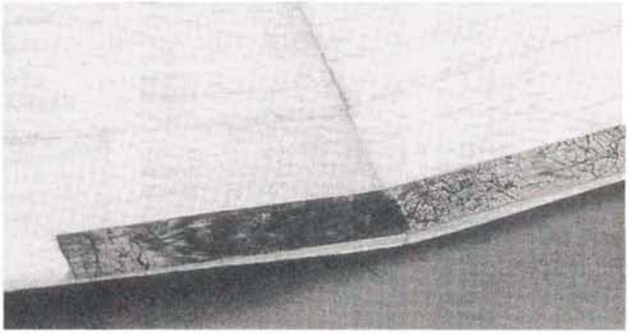
HOW TO:

RANDY RANDOLPH

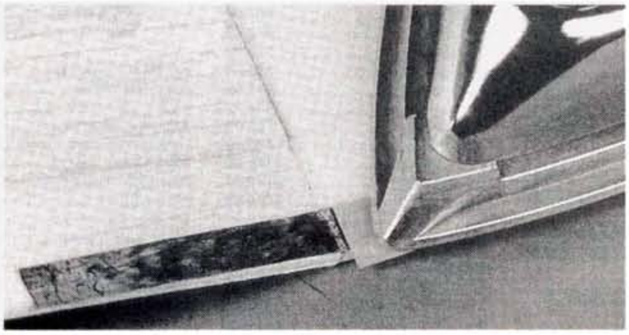
USE CARBON-FIBER TAPE AND ADHESIVE-BACKED FOAM TAPE

EVERY MONTH, NEW items and materials make their debuts in modeling magazines and on hobby dealers' shelves. Most offer methods that make assembly easier and quicker. California Carbon has two new products: an iron-on carbon tape and an adhesive-backed, shock-absorbing foam tape that slowly returns to shape and eliminates bounce-back.*

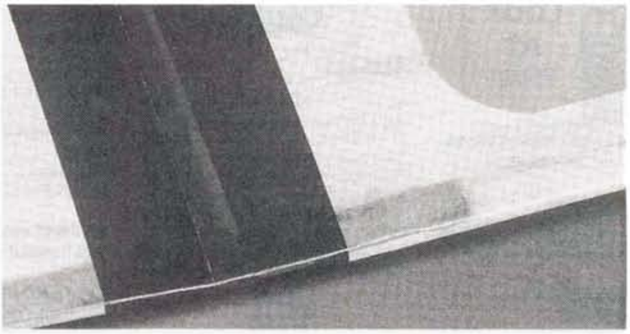
1. Carbon fibers have found their way into many facets of model construction. These fibers are impregnated with a heat-actuated cement for easier handling.



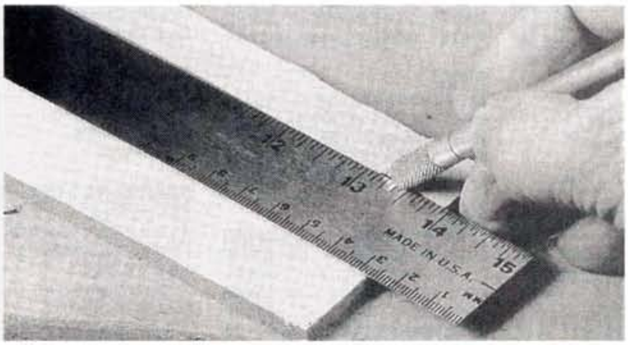
2. Rubber bands almost always cause damage to a wing's trailing edge unless you reinforce the area under them. An easy way to accomplish this, when using iron-on covering material, is to put iron-on carbon tape on the center-section trailing edge first so that it protects the area contacted by the rubber bands.



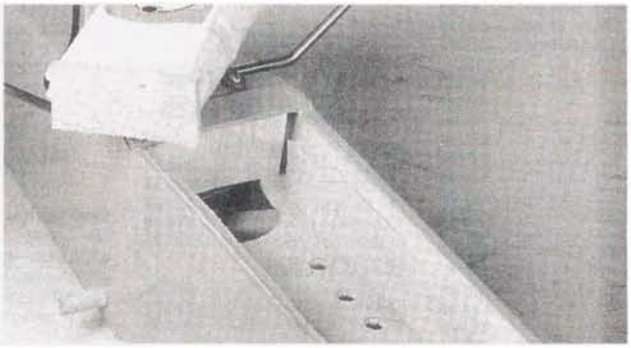
3. Start attaching the covering material at the wing's center section. Simply iron the covering material and the carbon fiber in place at the same time. Do not apply the hot iron to the carbon fiber tape because the tape will stick to the iron.



4. This system is also great for reinforcing spars at dihedral joints (not shown). Iron the tape and the covering material on the top and bottom spars of the finished wing.



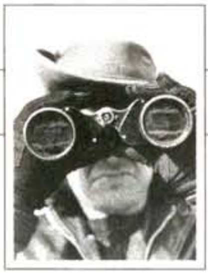
5. Using a straightedge and a razor knife, cut the adhesive-backed, foam tape to the desired shape. (Make your cuts from the back of the tape.) In this case, the tape was cut into 1-inch-wide strips to line the battery compartment of an electric airplane.



6. Peel the protective backing from the foam; it will stick to almost any surface. Here, the front of the battery pack is protected as well as the sides of the battery compartment. Receivers, fuel tanks and servos can also benefit from this shock-absorbing treatment.

**Here is the address of the company featured in this article: California Carbon, P.O. Box 39, Jamul, CA 91935.*

AIR SCOOP



CHRIS CHIANELLI

New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

THE SWAT TEAM

This year's Toledo show was not only a great success, but it was also a pleasure to attend, because it was held for a second year in a new, clean facility. Of course, Air Age Publishing was there in force. From left to right: Sharon Warner, Mike Stankiewicz, Shelley Byington, Louis DeFrancesco Jr., Tom Atwood, Julie Soriano, Gerry Yarrish and me. The following are snippets of R/C intrigue and adventure.

HACKERS NEED NOT APPLY

How long will it be before our radios come with built-in hard-drives (the external units have proven problematic at the field) and a mouse? I feel the transmitters of future models will be more suited to use at a skeet shoot than the club field during a Sunday flying session. If you're like me and don't want to read a phone-book-size instruction book before you can enjoy the hobby, Futaba has come to the rescue. Their new 7NFK Conquest 7-channel radio has features like elevon mixing, rudder and elevator mixing, throttle end-point adjustment and servo-throw adjustment (to name a few) conveniently at your fingertips under the front panel. Thank you Futaba from the bottom of our "anolog-idiot" hearts.

THE FUTURE LOOKS BRIGHT

In my opinion, by aiming its 81-inch-span T-6 directly at sport fliers, Midwest has done modelers, the modeling industry and itself a huge favor. Not only will this IMAA-legal warbird fly well with a relatively inexpensive .90 2-stroke engine, but its round fuselage also features a locking jig construction, so you can't mess it up! Midwest and designer Tom Herr are to be commended. The T-6 was the hit of the Toledo Show. Yes, folks; that's none other than world orbiter "Don Francisco" (Midwest president Frank Garcher) suited up and ready for action. Few know that Don Francisco is such an accomplished full-scale pilot that the U.S government and foreign governments seek his input on top-secret projects. The Don is fully checked out on airframes such as the F18, F15, F20, B2 and the Space Shuttle, just to name a few.

INSTANT ULTRA

The very popular Great Planes Ultra Sport 40 is now available in a 55-inch-span ARF version. The kit features a computer-designed, jig-built, balsa/ply structure that's covered with a finished-plastic composite skin. Its power requirements are a .40 to .46 2-stroke or a .60 to .70 4-stroke (optional retracts). Also new is the Great Planes improved metal clevis, but it's just the tip of the iceberg, because Great Planes has unveiled its new line of model parts and accessories—an extensive array of hardware, to say the least. Stay tuned to the "Scoop" for updates.

MULTI-BLADE POWER

Byron Originals now includes the much-vaunted Precision Eagle 4.2 engine in its multi-blade power-prop system for the Byron Hellcat, Corsair and P-47. The three- and four-blade system is proudly shown by Byron's Bruce Godberson. If you want to really carve up the sky, use it with two blades on the Byron AT-6! For more information, contact Byron Originals, P.O. Box 279, Ida Grove, IA 51445; (712) 364-3165.

HOG BIPE and FAZER

Sig Mfg. has given the famous Astro Hog a second wing! With a 52½-inch upper wing and 49¾-inch lower one, the Hog Bipe sports 1040 square inches of wing area. Designed by Harold Hester, the Hog Bipe is intended for a .50 to .65 2-stroke, or a .70 to .90 4-stroke engine. Also new from Sig is the 48-inch-span Fazer fun-fly design, which has a projected loading of 11.6 to 13.2 ounces per square foot. Look for these two at your hobby shop later this year.

LIGHTEST FORMERS?

Aeroplan Inc., has introduced an astoundingly light, strong former material called "Nomex." Developed originally for full-scale applications, it's made of epoxy-impregnated, honeycombed paper that's sandwiched between fiberglass or carbon-fiber facing. The 3⁄16-inch-thick, carbon-fiber-faced Nomex weighs a mere 3.5 ounces per square foot; it's available in thicknesses of ⅛, 3⁄16 and ½ inch. For more information, contact Aeroplan Inc., 75 Valencia Ave., Ste. 902, Coral Gables, FL 33134; (305) 448-5619.

COLOR-CODED

Rave's True Blend engine fuel was specially formulated for spot and competition helicopter fliers. Yellow (12.5 percent nitro with 20 percent synthetic oil), orange (25 percent nitro with 5 percent castor oil and 15 percent synthetic oil) and high-performance Black (35 percent nitro with 24 percent synthetic oil) are available. Contact Raves Mfg. USA, 6950 Edgewater Dr., #200 Orlando, FL 32810-4145; (407) 292-6888; orders only—(800) 733-HELI; fax (407) 292-9801.

THE NEXT GENERATION

For those of us who'd like more affordable, easier-to-use computer radios, Airtronics now offers the Quasar. Said to represent the next generation in programming simplicity, the radio features silkscreen prompts on parts of its LCD. This reduces the need to learn menus. It has end-point adjustments on all channels, dual rates on aileron and elevator, three-model memory, sub-trim on all proportional channels, and at least five built-in mixes. Heli (QS6H) and fixed-wing (QS6A) versions will be offered. The Quasar will be available around September this year.

LANIER LAZER

Bubba Spivey was given such resounding praise from the modeling world for his Stinger series that he has now applied the quick, simple Stinger building techniques to this all-new, 72-inch-span, ¼-scale Lazer 200. Designed for a .60 to 1.08 2-stroke, or a .91 to 1.20 4-stroke engine, this model has many ABS molded components to facilitate the construction of those compound curves. It will be available on August 1. Contact Lanier R/C, P.O. Box 458, Oakwood, GA 30566; (404) 532-6401; fax (404) 532-2163.

ELECTRO EXPRESS

Designed around the Astro FAI cobalt 05, the Electro Express from Model Engineering of Norwalk combines European streamlining with all-wood construction. This 36-ounce (with a 7-cell 1,000mAh battery pack), 66-inch-span, high-performance thermal machine will climb 600 to 800 feet (almost out of sight, if you're looking at the tail) in 20 seconds, but it's a gentle, stable flier. Contact Model Engineering of Norwalk, 54 Chestnut Hill Rd., Norwalk, CT 06851; (203) 846-9090.

HITEC'S SUPER-SERVO

This 605 servo from Hitec RCD Inc. offers super torque: at 4.8 volts, it generates 77 ounce-inches; at 6 volts, it generates 91 ounce-inches at a speed of .15 second. The finely engineered helical cut gear, made of engineering plastic, gives 25 percent more efficient power transfer with no backlash. Suggested retail price is $59.95. Contact Hitec RCD Inc.,10729 Wheatlands Ave., Ste. C, Santee, CA 92071; (619) 258-4940.

NELSON UNLIMITED RACING ENGINE

Famed racing-engine designer Henry Nelson (left) and national and international pylon-racing champ Dave Shadel (right) show off Nelson's latest design—a 5ci, "Madera-style" unlimited racing engine. Modeled after the hugely successful Nelson Formula 1 and Quickee motors, the engine will have a rear disk valve and AAC or ABC construction. For further information, contact Performance Specialties, P.O. Box 3146, Gardnerville, NV 89410; (702) 265-7523; fax (702) 265-7522.

RACING LANCAIR

The large number of unlimited racing planes at Toledo has further underscored the growth in giant-scale modeling. This Lancair IV from CBA Models was one of the most beautiful models eligible for the races. It features a fiberglass fuselage, foam wing and stab, retracts by Air Design, flaps, pre-formed window glass and many other options. The 102-inch-span, 26- to 30-pound model is available in full kit and fuse kit versions. To find out more, contact CBA Models, 1620 N. Leavitt Rd. NW, Warren, OH 44485; (216) 898-0900.

FABULOUS FRANK

It's a good thing Aerotech Models wasn't around to help supply the Japanese with the Nakajima KI-84 "Frank"; they sure could have put more of these 426mph fighting hot rods to use. This kit is prefabricated to an extremely high degree using graphite carbon-fiber technology. Just to give you an idea, all the panel lines are molded into the wing and fuselage, and all the surfaces are hinged. The landing gear is attached to an encapsulated aluminum main spar. All mounting plates for the gear, wing, engine, servos and tail assemblies come already installed, and the exact, 1/5-scale outline ensures high static scores. Documentation is available. Contact Aerotech Models Inc., 2740 31st Ave. S, Minneapolis, MN 55406; (612)721-1285.

A BIGGER STAR IS BORN

Futaba had such a favorable experience with its ARF version of the Acrostar 60 that it now offers a 1.20-size version of the Swiss aerobatic plane (also in ARF form). The Acrostar 120 will have a wingspan of approximately 72 inches and an area of around 850 square inches. The Acrostar 120 is bound to be a great performer, considering the demeanor of its smaller predecessor.

ULTRA-MICRO NEARS PRODUCTION

If you are intrigued by small models, note that Cannon Electronics' new Ultra-Micro radio is at last about to go into production. It meets all AMA narrow-band requirements and handles up to five channels. In its case, the receiver (only components are shown here) weighs only .4 ounce. A dual-balance mixer filters out noise from electric power systems. The servo weighs .3 ounce, including amplifier, gears, case and cable. With two servos, a battery and a receiver, you're looking at only 1.4 to 1.5 ounces. With four servos, the system weighs around 2 ounces. For further information, contact Cannon Electronics, 2828 Cochran St., Ste. 281, Simi Valley, CA 93065; (805) 581-5061.

LOW-VOLUME GIANTS

Two new pipes from Klaus Nowak at Aerrow Inc. help big planes perform better without rattling your eardrums. The engine attached to the pipe is the Gold Hawk Q100RS unlimited racing engine, but the pipe shown was designed for the standard Q100 6ci engine (or others ranging from 3.7ci to 6ci). Klaus claims the .8-pound Cobra QTM tuned pipe adds around 15 percent power to the Q100 while meeting a 90dB standard. The .9-pound pipe on the left—the Super-Cobra UTM—brings the volume down to approximately 84dB at 9 feet. That's nothing to whisper about. For more info, contact Aerrow Inc., P.O Box 183, 1881 Rogers Rd., Perth, Ontario, Canada K7H 3E3; (613) 264-0010.

ASTRO DIGITAL CHARGER

Serious electric-flight fans: Astro's new, digital, 36-cell peak-charger (left) made its first appearance at the Toledo show. (The currently available analog version is on the right.) This prototype unit appeared without silk-screened markings on its face, but it did demonstrate robust functionality (charge time, battery capacity, voltage at peak, voltage at trickle, etc.). A new Astro voltmeter/ammeter for electric fliers was also demonstrated (not shown). Prices were described as "very competitive." For more information, contact Astro Flight Inc., 13311 Beach Ave., Marina Del Rey, CA 90292; (310) 821-6242.

PRECISION GOLD-N-ROD All-weather accuracy

If you fly in widely varying weather conditions and are also annoyed by having to make slight trim changes when the temperature changes significantly, Sullivan's new Precision Gold-N-Rod is probably what you've been looking for. Formulated with a carbon compound, to the best of my knowledge, the Precision Gold-N-Rod is the only control linkage of this type that isn't affected by large temperature swings. For more information and the price of this and other high-tech Sullivan hardware, call (410) 732-3500, or write to Sullivan Products, P.O. Box 5166, Baltimore, MD 21224. Tell them you saw it in "Air Scoop"!

GROWN-UP SNAPPER

If you liked the original Snapper (middle), you are probably into combat or hot-dogging. The new Snapper 40, which was shown at the WRAM show a month before the Toledo show, brings its pint-size predecessor's wide speed range and aerobatic capability to you in a .25- to .45-size package. For further information, call Capstone R/C Suppliers at (800) 593-5250, or Aerocraft Model Mfg., at (516) 754-6628.

CHEETAH IS FAST

The Parkinson Cheetah and Jaguar (a larger trainer version of the Cheetah) are quick-to-build, ducted-fan jets that, according to Bob Parkinson, can get you into the air fast—15 hours, with the help of the videotape. Engine requirements are a .61 to .91, using a Dynamax or Parkinson Vector fan unit. For more information, contact Bob Parkinson Flying Models, Box 856, 11th & 25th, R.R. #1, Stroud, Ontario, Canada L0L 2M0; (705) 436-7041.

TN50 SAFE AND SOUND

The diesel-powered Turbomin TN50 should be safer than its propane-breathing brethren, and it will have a scale exhaust smell! For models weighing 11 to 17 pounds, the TN50's thrust is rated at 8 pounds and its exhaust velocity is measured at 50mph. It's 12 inches long, has a 4.8-inch diameter and weighs 4.6 pounds with electronic fuel pump and ignition systems. In the USA, it may be available next year for approximately $1,500. Contact Natans Hobby, Box 47, S-430 24 Väröbacka, Sweden; +46-340-60066; fax +46-340-65513.

CENTER ON LIFT

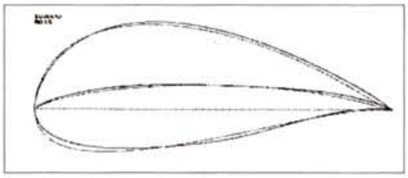
MICHAEL LACHOWSKI

AIRFOIL VISUALIZATION; LSF NATS

THIS MONTH, I'll talk about AFEDIT*—an airfoil visualization and editing program. I also have an update on the upcoming LSF Nationals, which promises to be another great, soaring gathering. Finally, I have a tip for hand-launch pilots and news about Flite Lite gliders that Airtronics* has added to its line.

AIRFOIL VISUALIZATION WITH AFEDIT

Dave Squires mailed me a copy of his latest version of AFEDIT. Read on because this is not just another airfoil plotting program. Dave's program complements other programs, e.g., Chuck Anderson's Model Design Program*, Cygnet Software's Foiled Again*, and Eric Sanders' CompuFoil* series. AFEDIT lets you preview airfoil shapes on the screen before you do any plotting. It imports coordinate data files from the Model Design Program and Foiled Again. You can preview up to three airfoils at one time. AFEDIT can plot three separate airfoils, or it can overlay all three plots. The airfoil plots use EGA or VGA color graphics, and each airfoil is color-coded.



This is a comparison plot of the RG-15 and SD8000 airfoils printed by AFEDIT. The airfoils are displayed with the vertical scale being 3x and the horizontal scale 1x. AFEDIT plots the airfoil, the camber line and, optionally, the thickness distribution.

AFEDIT expands the vertical and horizontal scales of the screen plot to magnify the airfoils and highlight subtle differences in the shapes. Airfoils are really measured in terms of camber and thickness distributions. This program can pull this information out of the airfoils and let you look at the differences in camber lines. While an RG15 and an SD2048 look almost identical, AFEDIT shows the differences in thickness and camber line.

If you like playing with airfoils, AFEDIT can modify their camber and thickness. It computes the camber line and thickness by taking the midpoint between the top and bottom surface; then it uses these to compute the new percentages of camber and thickness. This method does not exactly preserve the original camber and thickness distributions of the airfoil family, but it is within normal building tolerances. For real airfoil hackers, AFEDIT will combine top and bottom surfaces from different airfoils. It can export these changes back to Model Design Program or Foiled Again formats for template plotting.

The program is easy to use and includes an eight-page manual, which you probably won't need. AFEDIT is available from Dave Squires for $29.95 plus $3 shipping.

THE LSF NATS SCHEDULE

Don Goughnor's 1992 LSF NATS first-place, scale-winning Pratt-Read on final approach.

Get ready for the LSF Nats 1993. The second LSF National R/C Soaring Championships will be held in Vincennes, IN, from August 7 through 14. If you're interested in soaring, this is a contest you'll want to attend. The week opens with F3J Hand Tow. As long as it's not dead calm, this event will be fun. F3B soaring takes place on August 8, and the hand launch is held the following day. Besides normal hand launch, LSF president Mike Stump is planning on 18 holes of hand-launch golf. (See "Center on Lift" in the January '93 issue.) The three Thermal Duration classes will fly man-on-man competition on August 10, 11 and 12. There's no excuse for bad air here; your score is based on the best flight in your flight group. Last year, the winch crew did an excellent job of getting the entire group in the air in a very short time, and I expect that they will do even better this year.

If you've never flown Multitask, and you're not ready for F3B, consider the Sportsman Multitask (SMT), which will be held on Friday (the 13th!). Bring your unlimited or standard ship, and give this event a try. Launching and flying is man-on-man, just like the thermal events earlier in the week. Practice those smooth turns and straight lines for distance and speed. The final event will be the Cross Country. Scale flying will be held on Tuesday and Wednesday evenings after the two-meter and standard flying.

Do you need more information? Send a self-addressed, stamped envelope to Mike Stump, 607 Washington St., Cadillac, MI 49601. See you there.

AIRTRONICS ADDS FLITE LITE KITS

Airtronics has added many of the Flite Lite thermal and electric ships to its product line: the Falcon 600, 800, 880 and Thermal Eagle gliders and the Falcon 550E and 880E electric kits. All the kits will have fiberglass fuselages and pre-sheeted foam wings and stabs with factory-routed servo pockets and hinge lines. Full hardware packages and fully detailed plans and building instructions will be included in the kits. Look for a review of the Thermal Eagle in the near future.

STAYING IN THE THERMAL

Every hand-launch pilot likes to launch right into a thermal. Once you get the hang of it, you can feel the change in wind speed and temperature, and you know the conditions are just right. Once in the air, you have to stay in the thermal and follow it downwind. Unfortunately, your location and the location of the thermal are nearly the same. This is almost like trying to fly a regular thermal ship when the thermal is overhead. You have no perspective, and it's difficult to read what the glider is actually doing. The easiest solution is to just walk away from the thermal. As you step back from the thermal, it becomes easier to judge the attitude of your glider for the full circle, which improves your ability to fly within the thermal. Being away from the thermal, you can feel the wind shift towards the thermal. This gives you some clues as to where the center of the thermal is located and how fast it's moving downwind. Give it a try.

**Here are the addresses that are pertinent to this article:*

AFEDIT; *Dave Squires, 920 Quercus Ct., Sunnyvale, CA 94086; (408) 245-8111.*

Airtronics Inc., *11 Autry, Irvine, CA 92718.*

Model Design Program, *Chuck Anderson, P.O. Box 305, Tullahoma, TN 37388; (615) 455-6430.*

Foiled Again CYGNET Software, *3525 Del Mar Heights #237A, San Diego, CA 92130; (619) 792-8021.*

CompuFoil, *Eric Sanders, 3904 Traine Dr., Kettering, OH 45429; (513) 299-7684.*

PILOT PROJECTS

A LOOK AT WHAT OUR READERS ARE DOING

SEND IN YOUR SNAPSHOTS

Model Airplane News is your magazine and, as always, we encourage reader participation. In "Pilot Projects", we feature pictures from you—our readers. Both color slides and color prints are acceptable.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of 1993. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.

BUMBLE BEE EXTRA 3.25

For this photo, Charlie Siska of Fayetteville, NC, asked his 14-year-old daughter Robin to hold his first-ever scratch-built project—the Extra 3.25 (January '93 pull-out plans). Powered by an O.S. FP .25 2-stroke with a Tatone muffler, it's covered with black and Cub yellow MonoKote. The cowl and wheel pants are painted with Pactra Formula-U Raven Black. Charlie reports that he was both relieved and thrilled by the model's first flight.

KOOL KANARY

David Blankenship of Sacramento, CA, built this negative-stagger biplane (FSP02851) in less than six months. Dave powers his 14.5-pound Kool Kanary with an S.T. 3000 engine and controls it with a JR radio. He reports that this sport model flies extremely well.

BIGGER FUN-FLY HOTS

Bob Minick of Isle of Palms, SC, enlarged Dan Santich's plans for the Fun Fly Hots (FSP02932) by 20 percent to create this O.S. FS .61-powered version. It has a 48-inch wingspan and an area of more than 900 square inches. Bob modified the model's nose gear, ailerons and tail skid slightly. He also mounted the servos externally and strengthened the lower part of fuselage with an aluminum channel. Bob says his Hots flies extremely well, even at very low speeds.

NEW SWOOSE

Frank Maguire of South Portland, ME, built this lovely float-equipped Ziroli design (Model Airplane News plan no. FSP10892). The Swoose is powered by an Enya SS .40 BB engine and controlled by a Futaba radio. Frank covered the model with UltraCote and painted its homemade fiberglass engine cowl with Coverite's Black Baron epoxy paint. While still in high school, Frank flew U-control planes. This is the second model he has built since returning to the hobby after a break of more than 40 years.

PULL-OUT SQUADRON

Thanks to our pull-out plans, Paul Feight of Dumas, TX, has been very busy. From left to right are the Bee-Tween, powered by a Cox .049 Bee, the ½A-10 (FSP08922), powered by two Tee Dee .049s, and the Gnat, which has an O.S. .10 in its nose. Paul says all the models in his growing squadron fly very well and, with the Extra 3.25 (FSP01931) on the building board, he's still very busy!

PILOT PROJECTS

GROWN GNAT

Ian Stevenson of Victoria, Australia, enlarged the Gnat pull-out plans (January 1992 issue) by 60 percent to build this scaled-up version. Powered by a YS .46 ABC 2-stroke, this good-looking, 57-inch-span, 5.5-pound model flies extremely well. Ian made its foam wing using the root and tip ribs as templates. Ian, 52, made his first solo flight just two months ago. He only wishes that he had "started in this most challenging and rewarding hobby" years earlier!

SWOOSE 2

Steve Erdman of Cleghorn, IA, also built his Swoose from the '89 Ziroli design (FSP10892). Powered by a Saito twin-cylinder FA .90T 4-stroke and covered with Super Coverite, the finished model weighs 6 pounds, 10 ounces. This is Steve's first floatplane, and he says that it's easy to fly and its landings are slow and graceful.

FUN-SCALE HORNET ▶

Doug Hoff of Monroe, WA, powers this F-18 Hornet pusher (FSP0489) with an O.S. .32 2-stroke. It's covered with MonoKote—metallic blue and yellow trim—and Doug says, that believe it or not, this is his first pusher design after almost 30 years of modeling. He's building a second Hornet and looks forward to attempting some interesting formation flying.

DYNAMIC DUO

Jan Lodner of Tananger, Norway, sent us this shot of his two most recent projects—the Ultimate Bipe (FSP12901) and the Skyburner (FSP02921). The Ultimate is powered by an O.S. 1.20 Surpass 4-stroke, and Jan gave it a foam wing rather than a built-up wooden one. He modified the Skyburner by increasing its wingspan by 10 inches, lengthening its fuselage by 5 inches and raising the horizontal stab's center line. He also gave the model a fully symmetrical airfoil. Powered by an O.S. .91 ducted fan, this model is fast, yet Jan says he can land it slowly owing to the ¼ inch of washout he added to its wingtips.

SILENT BEE-TWEEN

Brad Hanson of Schaumburg, IL, built this Pixie—an electric version of Randy Randolph's pull-out plan of the Bee-Tween. Powered by a Hobby Lobby Mini Olympic geared motor and a 600mAh battery, Brad's model has made more than 50 flights! He controls it with a 2-channel radio and uses the elevator channel to turn the motor on and off.

DEBOLT'S EGGBEATER

Marvin Leazenby of Anderson, IN, has been having a lot of fun with his autogyro. Designed by Hal "Pappy" DeBolt (FSP09773), the O.S. .40 FP-powered model has a 48-inch wingspan and a 46-inch rotor span. Marvin uses a '79 Kraft radio on a 6-meter frequency.

MODEL AIRPLANE NEWS MAGAZINE CONSTRUCTION

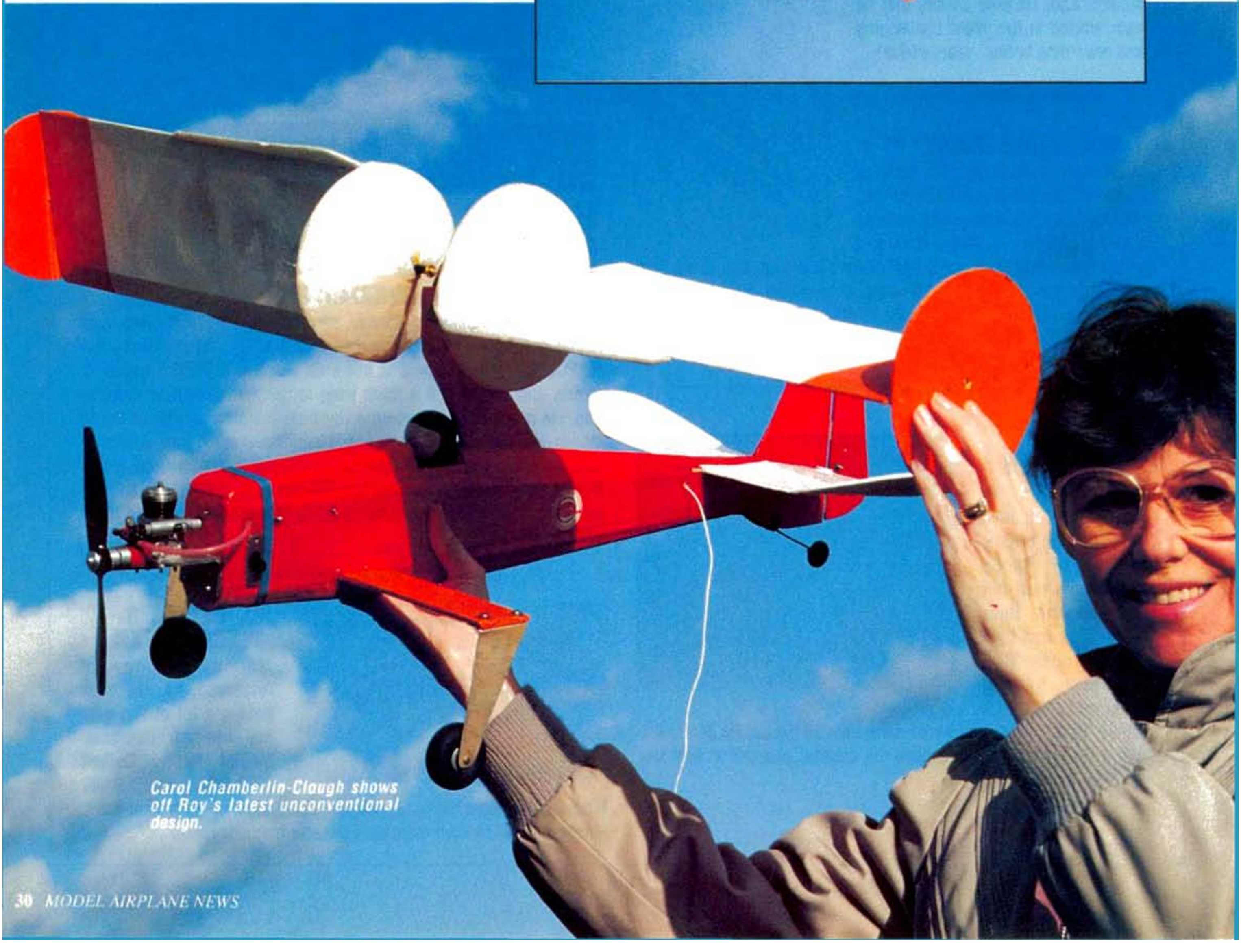
R/C Flettner rotor proof-of-concept

Rotorplane!

by ROY L. CLOUGH JR.

Editor's note: In this article, author Roy Clough shows you how to build a 2-channel R/C rotor-wing plane and speculates on rotor-wing aerodynamics. Do you agree with Roy's analysis? We would like your comments and will publish selected letters in "Airwaves" in future issues.

PHOTOS BY CAROL CHAMBERLIN-CLOUGH



Carol Chamberlin-Clough shows off Roy's latest unconventional design.

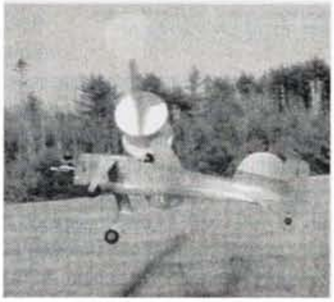
Spooky.

I had, sitting on my bench, a not-too-successful model rotor plane. The phone rang. It was Tom Atwood. He asked, had I, by any chance, done anything lately with Flettner rotors?

Sure had, Tom Atwood, and where did you get your license to run a crystal ball?

Turned out to be coincidence. He explained: he had been tossing around a 36-inch sheet of balsa to which he'd glued circular end caps. Flipped into the air with a lateral spinning motion, this crude rotor's lift and "glide" seemed impressive. Mulling it over, he recalled that I had long ago written about rotors of this type. What had I done lately?

In response, I sent him a flight photo of my rotor job—just barely airborne. I told him I was not happy with its performance.



Not happy? "Appalled" would be a better word. This recent ship didn't come close to the performance of my 10- to 12-ounce .049-powered rotor planes of 30 years ago.

Why? I finally figured it out: the weight of the R/C equipment, much too heavy construction, an engine installation that allowed the propeller blast to interfere with a rotor of less than optimum cross-section, and unnecessary outrigger bearing supports.

Nice going, Clough. Now use your 20/20 hindsight and try again.

Rotorplane! is the result.

A big breakthrough was a new rotor that spun true on a single central bearing. This avoided the drag, friction and uneven lift that had resulted from a split rotor held in outrigger bearing supports. The new design tied the rotor halves together. This improved stability in turns and permitted "90-degree phasing" for smoother running (rotor halves are mounted at right angles—see photos).

Finally, I yielded to nostalgia and designed the new plane to resemble experimental gyroplanes of the '30s. Their typical wide-stance landing gear and "dihedralled" tail planes fit into the requirements of a practical rotor craft quite nicely. The final product is an attention-getter that really performs.

SPECIFICATIONS

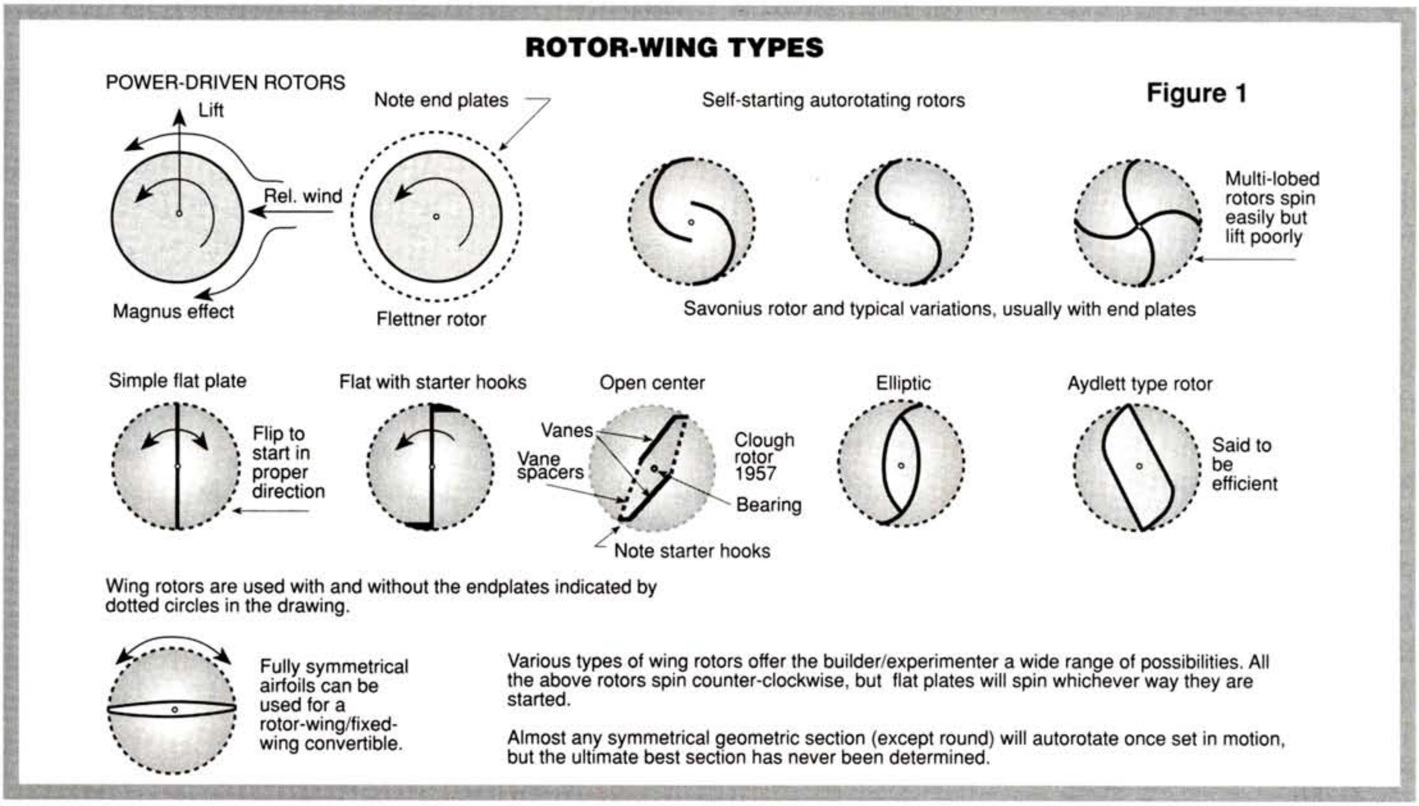
Name: Rotorplane!
Type: experimental sport
Rotor span: 37.5 in.
Rotor area: 183 sq. in.
Length: 28 in.
Weight: 25 oz. with fuel
"Wing" loading: 19.7 oz./sq. ft. of projected rotor area
No. of channels req'd: 2 (throttle and rudder)
Powerplant: Cox Medallion .09 (with throttle control)

Comments: this 2-channel airplane flies in much the same way as an autogyro. Rudder control is sufficient, because roll is coupled with rudder input (the rotors provide effective dihedral).

MUSINGS ON LIFT

What accounts for rotor lift? The first explanation to which I was exposed was that a spinning drum in a relative wind creates a pocket of "partial vacuum" on the top of the drum, 90 degrees back from the point of impingement of the relative wind. The rotor is supposedly sucked into the vacuum.

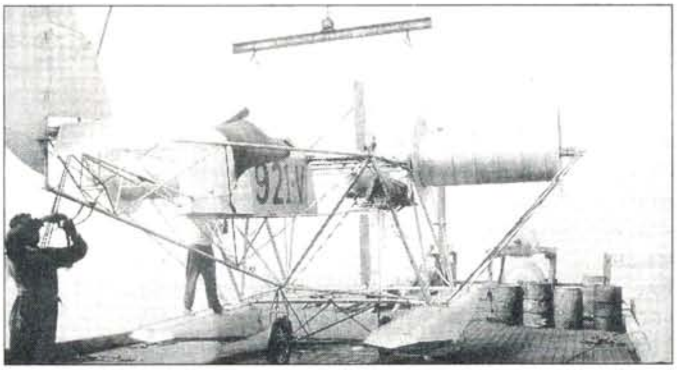
That seemed reasonable until another



Rotorplane History

Anyone who has ever flipped the cardboard out of a candy wrapper is familiar with the spinning, horizontal flight of a flat-plate rotor. What is the history of this approach to flight? "Magnus effect" (the reason rotors fly) is named after Heinrich Gustave Magnus, who died in 1870. A brilliant German physicist, he discovered and experimented with the effects of wind on power-driven cylinders (see Figure 1).

Many years later, Anton Flettner (also noted for his later cyclic-controlled autogyro and pioneering helicopter work) applied the Magnus rotor effect to several sailing ships. Notable among these was the Buckau, which crossed the Atlantic driven solely by the thrust of the wind against two whirling cylinders. Thus, "Flettner rotors" became the generic term for powered, spool-shaped rotors. Common use expanded the term to include all types of rotor.



This plane—part of an experiment to test the "Magnus effect"—was tried in the early '30s.

Sigurd J. Savonius made the Flettner rotor spin without power. He took the basic Magnus circular cross-section rotor, split it down the middle and offset the two halves to catch the wind to make it self-starting and autorotating.

I like the term "wing rotor"; in 1964, the Aerophysics Co. suggested it for single airfoils that rotate about a transverse horizontal axis. Note that "wing rotor" and Savonius cross-sections tend to merge as designers combine the features of each type.

Basic wing rotors have been around since long before successful fixed-wing planes left the ground. In 1853 James Clerk Maxwell published the earliest known paper on the subject. Basic flat-plate, "tumble-wing" rotors were applied to gliders and kites as early as 1903 by Koppen and Ames. Ames also experimented with powered flat rotors.

Several full-scale wing-rotor machines have been built. A few have managed to leave the ground, but none has proved to be a practical success. In 1934, Caudron built an experimental airplane with a convertible wing-to-rotor. It made several flights before structural failure caused the death of its pilot and ended the project. Other, apparently less successful, Magnus powered-cylinder rotor craft were built by Guest & Popper and Zaparka. (I have been bemused for decades by the Popper machine, because newsreel footage clearly shows the powered main rotor spinning in the wrong direction.)

ROTORPLANE MODELS

The Rotorplane model in this article is by no means the first successful model or even the first successful R/C rotor plane. Even my .049 free-flighters of the early '50s were preceded by a rubber-powered cabin model built by a young chap named Hatlestead in the late '30s. He used independently spinning Savonius-type rotors set at a dihedral angle.

H.T. Nelson built a model in which the wing had revolving center panels. It seemed to be very successful.

In the '60s, Bruno Horstenke built successful wing rotor gliders, free-flight and R/C models. He used flattened "S" cross-section rotors and mounted the engine and prop above the rotors where propwash could give them a little more spin—an idea modern experimenters might find worth looking into.

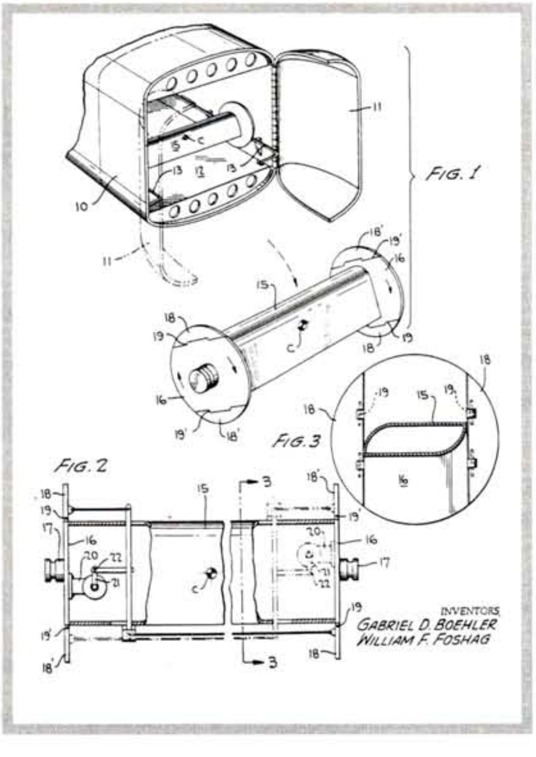
Notable, too, was the 1976 effort of Billy Walker, who applied the wing concept to an R/C gas model that could unlock and rotate more or less conventional wing panels for a nearly hovering let-down. Walker won several awards for his efforts. Built around an Ugly Stik, the model would fly with the rotor activated, but it isn't clear whether it would take off in the rotating mode.

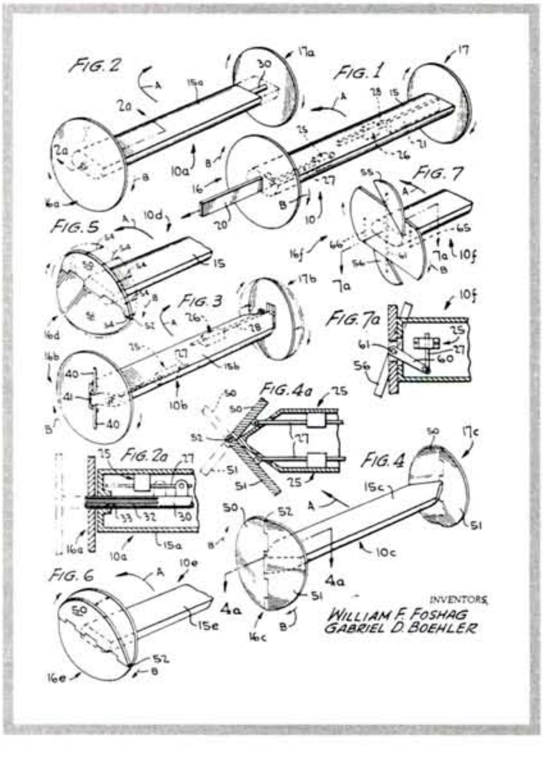
Bill Foshag has built and flown many successful wing-rotor kites, and he was instrumental in the development of a sophisticated cargo-drop rotor glider that could be radio-controlled all the way to the ground (see patent drawing).

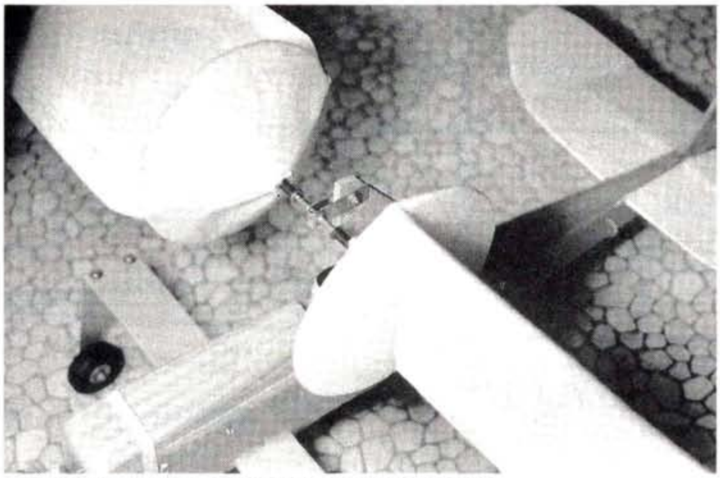
THE FUTURE

Builders of Rotorplane! who want to experiment further would do well to address themselves to rotor cross-sections. Although it has been written that the shape of a rotating body doesn't make much difference in the amount of lift produced (P.J. Hoffman, "Model Aeronautics Made Painless"), a few simple experiments will show that there is a considerable difference in drag.

The ideal rotor shape has yet to be discovered. Although the classical Savonius "S" rotor with its curvy elegance and structural strength continues to be used for everything from omnidirectional windmills to display signs and toy kites, its flight performance is inferior to that of a simple flat plate. This could be a big opportunity for cut-and-try experimenters. Sophisticated airfoil development requires oodles of high-tech goodies, but you don't need a laboratory full of apparatus to tell you whether one rotor glides farther than another.







A central rotor-wing mount proved superior to separately mounted rotor wings. Mounting the wings out of phase doubles the frequency of so-called "flat periods" and smoothes rotation.

instructor explained wing lift according to Bernoulli's theorem: a fluid flowing over a surface or through a restriction creates an area of low pressure. Most of the wing lift results from air being speeded up over the cambered airfoil. This supposedly produces a "partial vacuum" into which the wing is sucked.

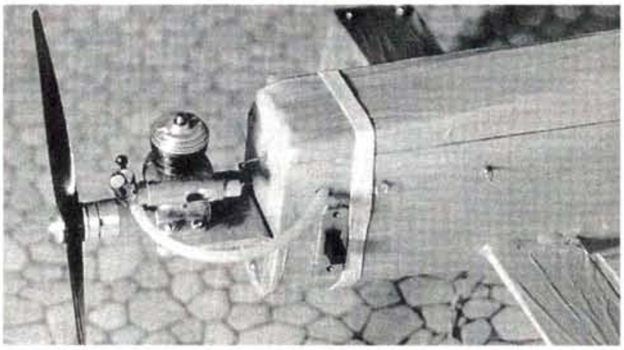
That was confusing to this kid: if most wing lift occurs on the surface over which air is moving fastest, how come the lift of a spinning rotor came over the retreating surface where the airflow was slowest?

I wasted some time learning glib explanations produce partial vacuums into which naive minds are sucked. The late science fiction editor John W. Campbell Jr. and I dreamed up a wonderful flying machine during a bull session in the *Analog* editorial office. We noted that Bernoulli's theorem states that a fluid moving across a surface produces lowered pressure. Ergo, make a disk-shaped aircraft split into two sections. The bottom half of the craft would be stationary and would contain the machinery, the crew and all that good stuff. The top would be spun at high speed. The high velocity interface between the air and the surface of the rapidly revolving disk should result in a powerful "suction" with lift equivalent to that which would be produced by the same surface area travelling through the air at a comparable speed. Terrific! Take off vertically, then tilt down the front edge and scoot off like a helicopter!

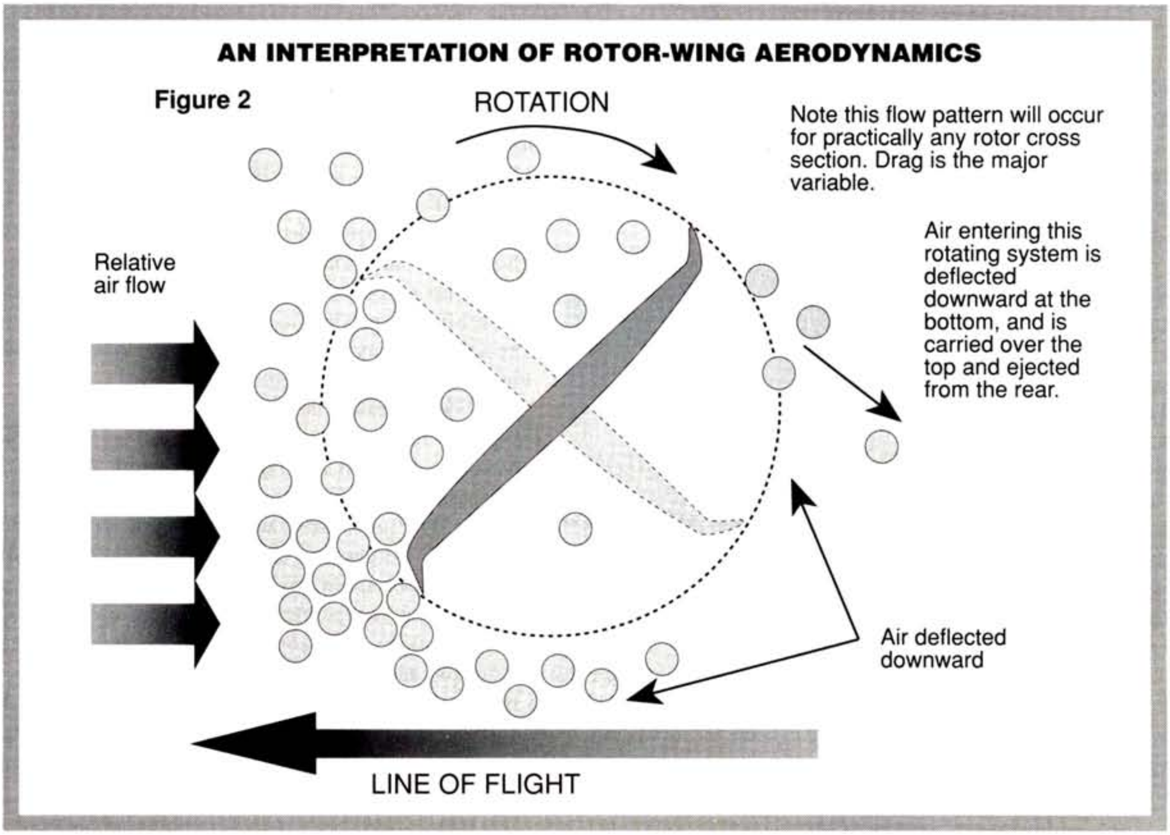
I built it. I tried it. Nothing of the sort happened. There was no lift, just a barely palpable breeze off the rim of the spinning section. Finally, after several variations, which included augmenting the spin with a blast of air from centrally mounted propellers, the folly of the notion became apparent. The models were stored and, when later destroyed by a trio of vandalizing youngsters, not greatly mourned.

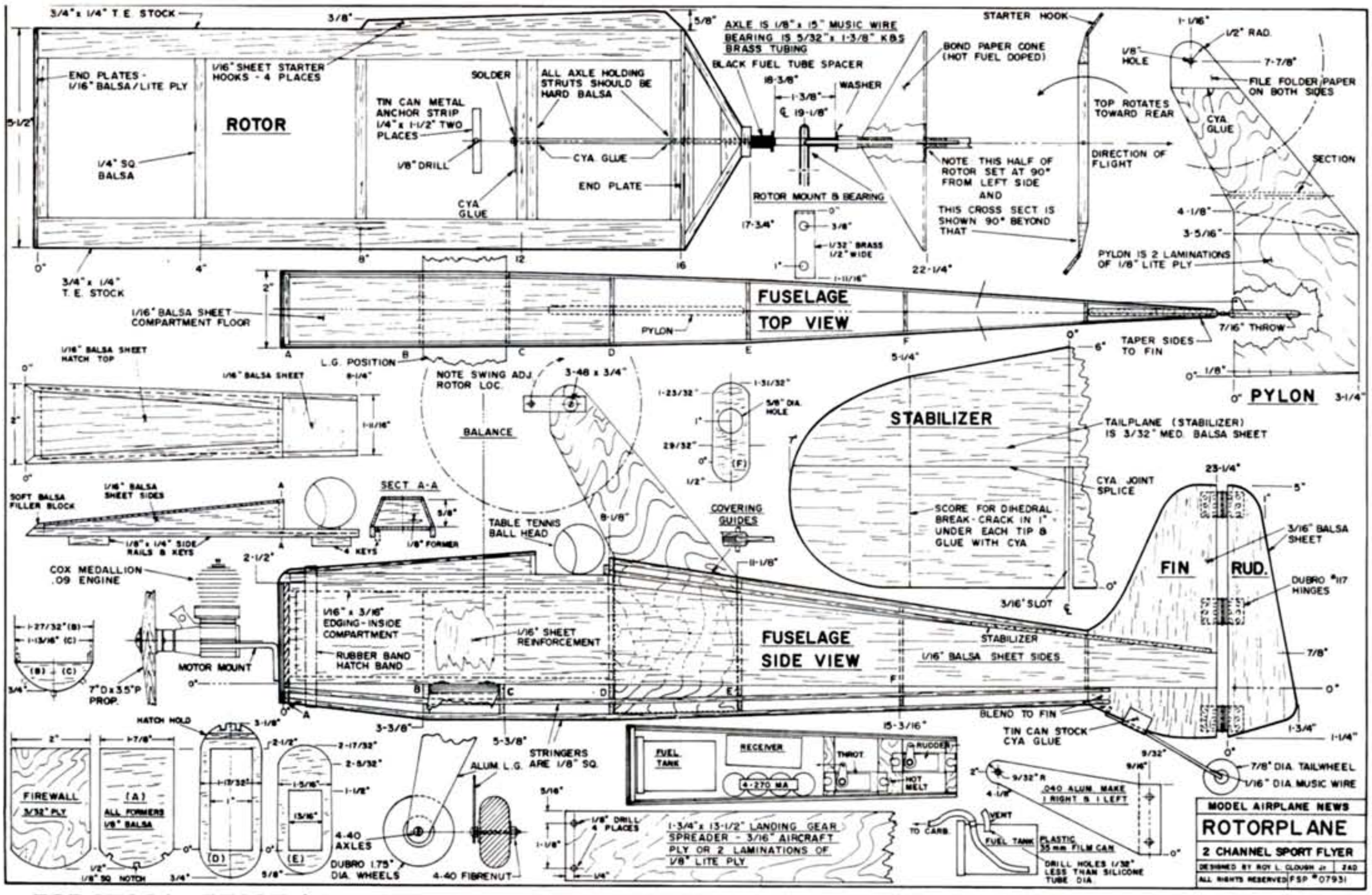
As time went by, I built an occasional rotor plane. I recently found an early '50s picture of me watching a .049-powered rotor plane climb up out of a hand-launch. I also wrote "Theory of Rotorplanes," *Model Airplane News,* May 1949, but did not explain rotor lift as the result of a "partial vacuum." That year, in the July issue, Roland T. Mayer published a clever control-liner, "Flutter Wing" that had a symmetrical rotating element within the wing. A few years later, I published a control-liner with a cross-flow ventilated rotor *(American Modeler,* March 1957).

When I built that unsatisfactory R/C rotor plane in 1990 and, coincidentally, Tom Atwood saw fit to call me, I was goaded into backtracking over theory to find out whether



The Rotorplane! is best powered by a Cox Medallion .09 engine.



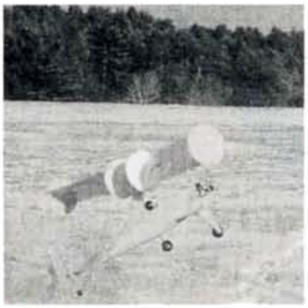


FSP 07931—PRICE $10—ORDER THE FULL-SIZE PLAN ON PAGE 113.

what I *thought* I knew matched what really happened. Let's get a little hands-on rotor savvy.

ROTOR-WING AERODYNAMICS

Cut a few strips of stiff paper, making them 8 or 9 inches long and a couple of inches wide. Toss one into the air. After a brief tumble, it will start to spin automatically, at a seemingly constant rpm, as it descends along its glide path.



What makes it spin? When the randomly tumbling strip is positioned edgewise to the relative wind, it acts like a wing. Pressure builds up under its leading edge and flips it up past the vertical. Past the vertical, the trailing edge becomes the leading edge and the process is repeated. Autorotation is quickly achieved, and this simple flying machine settles into an apparently rock-steady glide.

Rock-steady?

Draw a heavy black center line lengthwise on each side. Now keep your eye on this axial reference as the strip glides. Seems to blur a little? Rotation, as you see, isn't smoothly constant. It pulsates, speeding up and slowing down twice during each revolution. The resulting chordwise oscillation "fuzzes" your mark.

Pulsation increases drag and reduces lift. It will always occur with a wing rotor, especially a flat plate. We can't get rid of it, but it can be minimized. Our model uses a rotor with the right and left halves set at 90 degrees. This doubles the frequency and halves the amplitude of chordwise movement to make the rotor run more smoothly. Surprisingly, as shown by many in-flight videos, the right-angled "flats" do not result in side-to-side rock 'n' roll. (According to Bill Foshag, who has a lot of experience with wing rotors, end-plate "flywheel" weights are also effective in maintaining rotor speed during the pulsations that are caused by these flats.)

Now, since our little paper wing rotors automatically start to spin and lift no matter how we launch them, can we (begging off questions of efficiency) regard them as an ultimate stall-proof, fool-proof lifting device?

Not really. Keep flipping your little paper rotors and, sooner or later, you'll see one upend and plunge sideways. This is the rotor's equivalent of stall and spin. It happens when spanwise flow disrupts chordwise circulation. Bending your strips into a shallow lengthwise vee, or turning up the ends, or adding circular end plates will minimize plunging and increase lift. Turbulence or control forces can still force an end plunge, but recovery is quicker.

But what makes a spinning rotor lift? Thrust is clearly developed on one side of it, but why the "up" side? Why not the "down" side? What clue does the rotor get from gravity?

SUPERSTALLING?

I found that tough to ponder. Perhaps "superstalling" was involved? Superstalling occurs when turbulence creates a vortex which stubbornly sticks to the surface generating it. Think of a "superstalled" wing as caught up in a self-generated tornado that supports its sink rate at a velocity that's too low for there to be any chance of re-establishing normal airflow. It's a very bad scene for a passenger-carrying plane—one that invariably winds down to silver handles and slow music.

To me, it seemed reasonable to suppose that what was fatal to a fixed wing might be the natural mode for spinning rotors. It would certainly be a glib and facile explanation. Unlike a normal wing, which sustains weight by deflecting a reaction mass of air downward, a spinning rotor might sustain itself by creating an "attached vortex." Neat. This would mean we could explain rotor lift and attribute end-plunging to a spanwise flow wiping off the sustaining vortex.

But the explanation is probably too neat. If spanwise flow could wipe out a sustaining vortex, would not chordwise flow, which occurs twice every revolution, do the same? Vortices created by a churning rotor would not stay attached, but would be flipped off as disturbances in the rotor's wake. There goes your theory, Clough: you can't make the whistle pull the train!

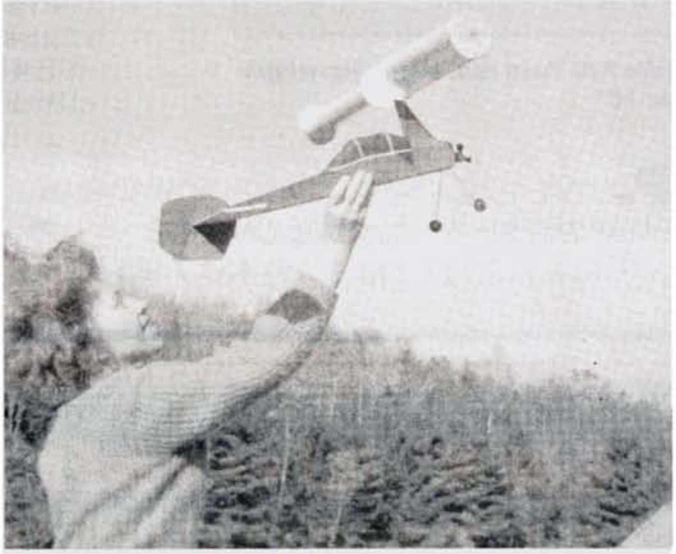
Earlier, I reasoned that air was sufficiently viscous to hang together long enough to be thrown off a rotating element and produce a reaction: lift. This might seem reasonable for spinning Magnus cylinders, but it didn't really satisfy the case of flat and streamlined shapes. Any good explanation should accommodate not just rotors, but also whatever we think we know about propellers and wings.

BACK TO BASICS

Let's take a shot at my current reasoning: Visualize the ocean of air in which we live, breathe and fly, as a big bin full of very tiny table-tennis balls. These bouncy balls slide over one another easily, and pushing on any one transmits energy to those around it. Air "pressure," in all directions, is simply the result of their weight. (Kinetic theory says that these particles are in constant motion, jiggling and bouncing around in proportion to their thermal content. The length of their "jiggles" depends on how tightly they are packed, so as we go higher, the lessened pressure from other balls permits longer individual jiggles and fewer balls in any given volume.)

Bernoulli's theorem: take a tube with a restriction (venturi) in it and rapidly scoop away the table-tennis balls from one end. Once the space has been made available, the weight and pressure of balls at the other end forces them into the tube. The balls roll and slide down the tube until they enter the venturi (restriction), which diverts their direction of flow and speeds them up in the process. Now, if we make a hole in the restricted section of the tube, will the balls leak out through this hole? No. They can't because the pressure is greater outside that hole. The swifter balls inside have traded off some of their outward push for an increase in velocity, and they no longer balance the push of the outside balls. The latter now push inward and are carried along in the rush.

Pressure is all we need to describe venturi effects. There is no need for, and there's considerable difficulty with, resorting to some imaginary force called "suction," which would require us to imagine that our table-tennis balls are somehow strung together with invisible threads so that pulling one drags others after it.



Pauline Powers launches a Roy Clough rotor-plane design. The plane was powered by an Atwood .049 and used a 5-inch diameter rotor. (The photo dates from the late '50s.)

Now push a wing through this mass. Balls that touch its flat undersurface push at that undersurface (because of the pressure of surrounding balls) as the wing deflects them. The balls slide and roll as they flow back toward the trailing edge. (You can think of the sliding balls as laminar flow, the rolling balls as turbulent flow).

On the top side of the wing, balls pushed up and over the camber by the leading edge are squeezed against the massed balls above the wing and are forced into a sliding and rolling "downhill" flow toward the trailing edge. This speeding of flow and releasing of pressure along the upside, "downhill" slope results in more lift being added to that produced by the underside. The reaction of the wing to both flows is analogous to a watermelon seed being squeezed between thumb and forefinger until pressure resolves into thrust and it zips away. Thus, airfoils glide forward with the power off, and above a certain minimum speed, an autogyro or helicopter rotor, will autorotate even when it's tilted up to a *positive* angle of attack.

When we drop our flat "wing rotor," it starts to sink through the "table-tennis balls" but, following the natural cussedness of inanimate objects, it does not drop very straight for very long. Inevitably, it tilts and starts to ride over the balls instead of "knifing" them aside. The balls push back, the advancing edge is lifted, and the retreating edge sinks because of the pressure of balls that circulate around it. Once it has sunk past the vertical center, the trailing edge becomes the leading edge as the system starts to rotate. (You've already seen the action with your paper rotors.) Energy to initiate and maintain this gliding rotation is, of course, supplied by gravity. This answers the question of how the rotor "knows" which way is "up."

Since the revolving wing's advancing lower edge is continuously rotating upward and over the top, it scoops up "table-tennis balls" like a paddle wheel and thrusts them downward and to the rear. The resultant circulation is like that produced by a cambered wing that sustains itself by deflecting air downward.

CONSTRUCTION

Rotorplane!'s construction requires little explanation. The fuselage has sheet-balsa sides that are braced by bulkheads and faired out with stringers. With the exception of the firewall backup bulkhead, the formers aren't notched.

The tail fin/sub-fin, rotor pylon, tail plane and plywood landing-gear spreader are all part of the fuselage structure. I covered the original fuselage with medium-weight silkspan (water-shrunk, clear-doped and finished with Aerogloss orange). I, by hindsight, recommend the use of light, iron-on film, as I did on the rotors.

The "spraddle-legged" landing gear looks

(Continued on page 78)

Sporty Scale Techniques

FRANK TIANO

SCALE CLUBS & THE GROWING SPORT

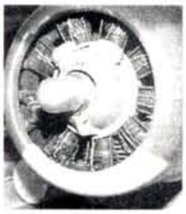
LAST TIME WE talked, I listed a few sources that I frequently use to provide scale documentation. I forgot to mention that one of the most important ways to get additional information and techniques for very little money is to simply join a club! Now, we all know that most clubs are just gatherings of local modelers who share one common interest: flying model aircraft. And most clubs have a limited number of members who are really into scale, but the key words here are "most" and "limited." What I mean is that there are usually at least one or two club members in any club who are interested in scale, and that's all you need. In many cases, this number has grown to the point where a splinter club has been formed where the only interest is scale. These clubs have grown to accept members from outside their immediate area and have gone on to host some pretty neat scale events. So, add some of those events to your list of where to go to learn new techniques, see new designs and meet some great people. A few clubs that come to mind are the California Scale Squadron, the One-Eighth Air Force, the One-Fifth Air Force, the Steamer Squadron and, of course, the indescribable "F-Troop."

The original F-Troop. Note the smart uniforms, matching pants, common hats, identical hair styles and similar smiles. (Not!) It all started with these five guys. You can do it, too.

Let's talk about F-Troop for a minute. While it has a lower profile than some other scale clubs, the prime reason for its existence is to "put the 'F' back in flying and building scale aircraft." F-Troop was founded in 1981 by five scale-modeling buddies: Steve Alvarado, Mike Bruce, Rick Cassell, Pete Sepulveda and Lew Vaughn. Since their first meeting in a garage, they have developed a large scale network that concentrates on just military scale models, and they make no bones about it. That's what I admire most about them—the no-bones part! The club has expanded to about 50 members, and it holds informal monthly meetings and makes several trips a year to various contests and air shows, sometimes to compete as a group and sometimes just to raise a little dust and have a good time. They have one of the absolute best newsletters you've ever seen and, according to their newsletter editor, Pete Sepulveda: "We've got just as many old codgers and 'hammers' as any other club our size. Our hammers are just scale hammers! Where other clubs crash the usual amount of trainers and sport ships each week, we do our crashing with P-51s, P-47s and FW-190s!" F-Troop is surviving quite well in Southern California, and it has added several names of dubious honor to its ranks; among them are Al Casey, Charlie Chambers, Dennis Crooks, George Leu, Jim Meister, Dick Techenor, Kent Walters and yours truly. You can learn so much more and have so much more fun doing it if you have a common interest such as an all-scale club. Call up two or three of your pals, and give it a try. You'll love the experience.

Kerry Sterner and his very own Beechcraft Starship. It has since been test-flown. The reason for the thumbs-up sign is that he was able to lift and balance the sucker for this picture!

It's new and I knew it! Nick Ziroli's big P-61 Black Widow should do well on two Q-35's and up. It's all wood with plastic and glass parts. For those who need that little something extra.



No, it's not some new shriner helmet. It's Nick Ziroli Jr.'s new addition to the FTE-cast dummy radial engine. For even more realism, Nicky molds an ABS add-on engine center case. Right now, it's only for the 1/5-size engine Call him; not me!

PREPARING FABRIC COVERINGS

As promised, I'll respond to a couple of questions this month. First, someone wants to know the "right" way to prepare fabric coverings for paint. My

answer is to follow the manufacturer's directions to find out what products are compatible and non-reactive with the covering. I use Super Shrink Coverite* quite often and find that after shrinking it, a couple coats of Sig* Clear Dope form a great foundation that requires only one light coat of lacquer or epoxy primer. Some fabrics, including Coverite's, will accept some primers right from the start, and that's fine, too. To ensure perfect adhesion, just be sure that the surface is absolutely squeaky clean before you apply the primer. If you don't take this precaution and you go ahead and mask off a color scheme, you may find that when you remove the tape, it will peel off some of the paint right down to the bare fabric!

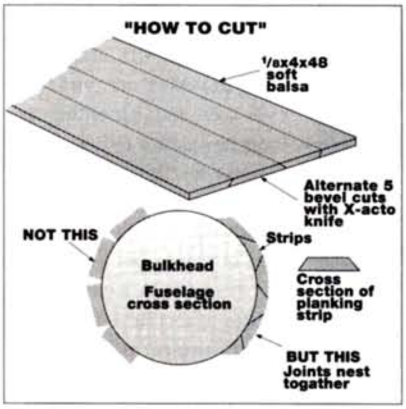


Diagram of planking strips

PLANKING ROUNDED FUSELAGES

Another modeler asks if there's any easy way to plank a round—or sort of round—fuselage. The answer is yes. Besides the old soaking-the-balsa-sheet-in-ammonia-and-water trick, you can individually plank your fuselage with 1/8x1/2-inch balsa planks—a job that's a lot easier than you might think. The secret is to take a 48-inch-long piece of good-grade 1/8-inch-thick balsa and cut the 1/2-inch planks by holding your knife tightly against a steel ruler at a 5-degree angle. Alternate your cuts by leaning the knife to the left and then to the right so that you wind up with beveled-edged strips. These strips will nestle against each other quite nicely and make the planking job almost a pleasure. As an added bonus, you increase the strength of the glue joints by more than double at no cost in weight. I use Zap-a-Gap* glue between each plank and give a little shot of kicker to the joint before proceeding to the next plank. Also, I alternate the planking from side to side. If you're as confused reading this as I am trying to explain it, see Figure 1.

Top: Pat McCurry's prop-driven Byron P-51 couldn't get too much lower to the deck because of the tremendous prop diameter. Middle: a nice shot of Billy "Porkchop" Harris's F-86 Canadair. Pictures of scale models are getting harder to distinguish from the real thing. Bottom: Tiano's Jug moments before touchdown. The 26-pound bird flies well with the ST 4500 and Platt competition retracts. This old Bert Baker kit has been repainted four times, and the wing has been replaced three times. It has been powered by a ST 2500, a Webra Bully, a Zenoah G-62, the O.S. 3500 and the new Tigre.

SCALE FLY-IN

One of the next-best things to a first-class scale contest is a first-class scale fly-in. You know—a gathering of scale modelers, or, in this particular case, "A Rally of Eagles," hosted by that fabulous northern Florida club, the Marianna R/C Club. Man, what an unusual name! Anyhow, these guys put on an all-fun event in October after the contest circuit is over and done with. We've gone up for the past two years, and I gotta tell ya that you're just not gonna find a better place to unwind, meet some great people and witness some fabulous flying. We had about 45 of some of the hottest pilots in the country show up for two and a half days of nothing but scale model airplanes! No competition, no rules (other than the safety variety), no dB requirements, no limits and no baloney (except the sandwich variety). Lotsa hotdog flying prompted some yoyo (I mean me) to offer 50 bucks in cash to the guy doing the lowest pass. Well, I wanna tell ya, everybody got into the act, and it became a real chore to judge who was the lowest. Finally, at Saturday's dinner, the prize was awarded to the two guys who tied—Art Johnson and Pat McCurry. Funny; both were flying Mustangs. Only Pat's was of the Byron variety, and the Colonel's was a twin!

If you get a chance next fall, try to make it to the Rally. One thing's for sure: you won't see any hangar queens that don't fly. For example, Jerry Caudle's F-16 was flown six times. In fact, we had one WW II scramble where we had 12 fighters in the air in a right-hand pattern chasing each other, diving, juking and

rolling and just having a ball. Then the jet jockeys got together and put up eight jets for the same type of rhubarb. Talk about exciting! And guess what?—not one accident.

That's it; I'm outta ideas for this issue, but take a peek at the cool pictures I got from some of our scale fans. Interest in scale is growing like crazy. Modelers really want to fly stuff that looks like real airplanes. Most new kit releases at least resemble a real airplane. The slim sticks, swizzle sticks, walking sticks, quick sticks and dip sticks have about run their course. Thanks to guys like you and your buddies, the guys in F-Troop, and events like the IMAA Festival, Scale Masters and Top Gun, scale models are the most sought-after models, and I, for one, think the

Just had to show these guys at the Rally of Eagles. Left to right: Leonard "Skinnard" Bechtold (crew chief), Frankie T. (pilot) and Joe Manzella (Top Gun CD) and T's XP-47Q Thunderbolt with an awesome Super Tigre 4500.

change isn't a trendy one. Nope, I think scale models are here to stay!

Until next month, remember that the only time you're allowed to read this mag from back to front is in the sandbox. Your six is clear!

**Here are the addresses of the companies mentioned in this article:*
Coverite, *420 Babylon Rd., Horsham, PA 19044.*
Sig Mfg. Co., *401 S. Front St., Montezuma, IA 50171.*
Zap-a-Gap; *manufactured by Pacer Technology and Research, 9420 Santa Anita Ave., Rancho Cucamonga, CA 91730; distributed by Frank Tiano Enterprises, 15300 Estancia Ln., W. Palm Beach, FL 33414; Robart Mfg., P.O. Box 1247, St. Charles, IL 60174; House of Balsa, Inc., 10101 Yucca Rd., Adelanto, CA 92301.*

HOW TO

Build a Sliding Canopy

by MIKE RICHARDSON

A MUST FOR ANY SCALE WARBIRD

My Focke-Wulf 190-D9 model was at the '91 Top Gun Invitational in West Palm Beach, FL. It's built from a Bob Holman* kit and has a fiberglass fuselage. The sliding canopy is easy to reproduce.

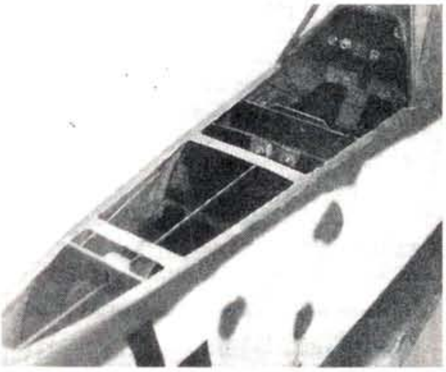
WHENEVER I GO to scale contests, I like to see functional, sliding canopies on the finely detailed models. All too often, a good-looking model hasn't been taken far enough and requires just a little extra effort to enhance its appearance and earn extra static points at the judges' table.

1 To make a sliding canopy, first smooth and flatten the canopy platform area on the fuselage with a large sanding block. Remove any rough seam that might run along the length of the fuselage. Start with 80-grit sandpaper, and finish the surface with 220-grit. Next, mark the areas that you'll need to cut, leaving a 3/8-inch-wide flange on the sides. Mark off two 1/2-inch-wide cross-braces, and remove the areas shown in Figure 1. To prevent cracks, round all the corners.

2 Cut the canopy apart along the separation line (Figure 2). The front windshield will be permanently attached to the fuselage.

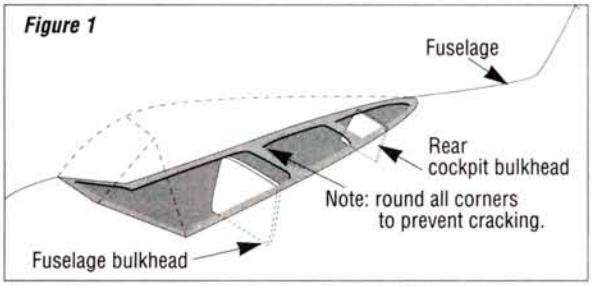
3 Make paper templates by tracing the inside of the canopy openings, and use these templates to make the upright frames and the canopy base out of 1/8-inch-thick plywood. (I used Mighty Lite* plywood.) The canopy bulkhead can be made out of balsa. Make sure that all the parts fit precisely and that the canopy doesn't warp or twist when they're installed (Figure 3). Don't glue anything yet.

(Continued on page 42)



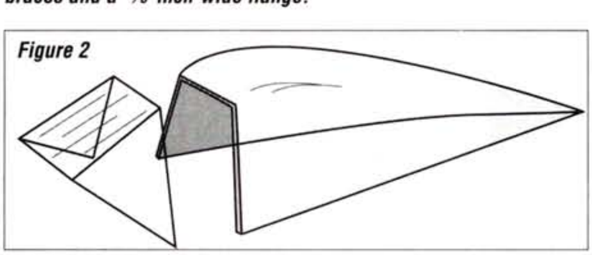
Cut the flat canopy platform out of the fuselage, leaving two cross-braces and a 3/8-inch-wide flange around the sides. The guide wire and a slotted, hardwood block are visible here.

Figure 1



Cut out the canopy platform, leaving two 1/2-inch-wide cross-braces and a 3/8-inch-wide flange.

Figure 2



Cut canopy along separation line.

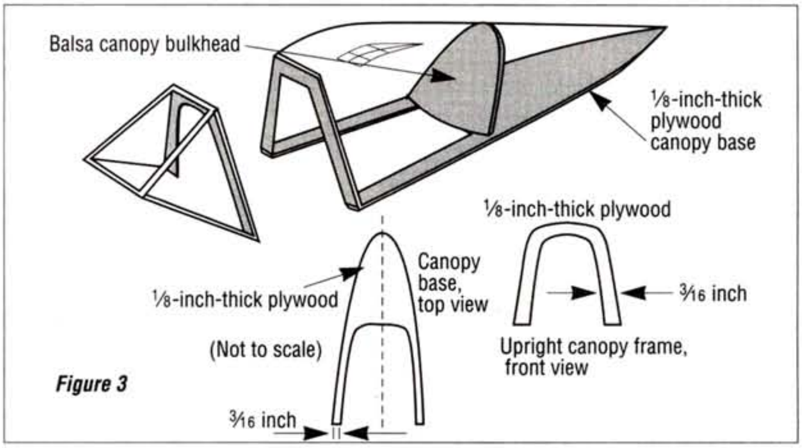
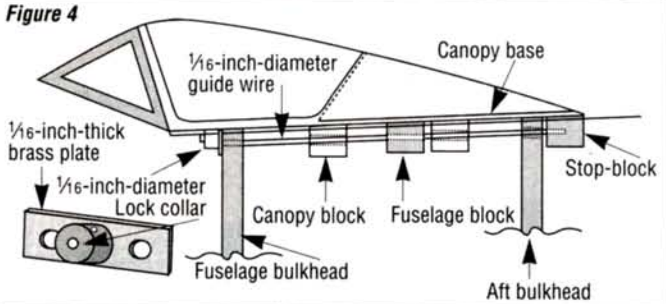


Figure 3

Use paper templates to make wooden reinforcement frames and a wooden bulkhead and base.

Figure 4



The canopy is held in place and guided by the guide wire. In the fuselage, the wire is held in place in front by a lock collar that's soldered to a brass plate that's screwed to a bulkhead; in back, it's held by a stop-block. The two blocks that are glued under the canopy base are drilled so that they slide along the guide wire.

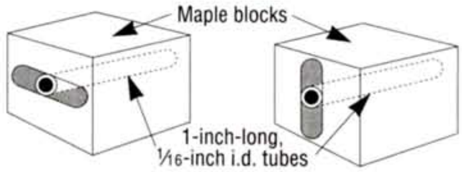
Mount the plate onto the bulkhead. When you solder the collar in place, position the setscrew hole so that the setscrew will point up and out of the fuselage. This way, you'll be able to adjust it much more easily.

4 To make the guide-wire supports, cut two ½x1x1-inch maple blocks. In each block, cut a ⅛-inch-wide, ¼-inch-long vertical slot so that the 1/16-inch rod that holds the canopy down can "float." Then, cut two, 1-inch-long pieces of 1/16-inch-i.d. brass tube. When you fit the canopy onto the fuselage, these tubes will be glued into the slots as guide bushings for the guide wire (Figures 4 and 5).

This shows the completed sliding canopy with the guide wire slid into the blocks. The horizontal slots in these blocks permit proper alignment of the canopy and the fuselage before the brass tubes are glued into them.

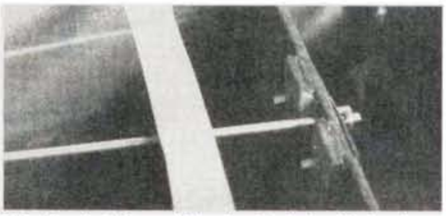
5 Glue the two maple blocks into the fuselage. (I used Zap* glue.) Attach them to a bulkhead or under one of the cross-braces, depending on your model's needs. For added strength, add fiberglass cloth to the blocks. Lock the guide wire into place with a 1/16-inch-diameter lock collar that's soldered to a 1/16-inch-thick brass plate, and screw the plate to a fuselage bulkhead. Solder the collar onto the center of the brass plate, and then drill three holes in the plate: one on each end for the mounting screws and one through the collar and the plate so that the guide wire can pass through them.

Figure 5



A. The blocks attached to the canopy base are slotted horizontally so that the canopy can be aligned with the fuselage.

B. The blocks attached inside the fuselage are slotted vertically so that the guide wire can be supported at the correct depth and so that the canopy slides easily.



The front of the guide wire is locked into place with a lock collar that's soldered onto a brass plate. The plate is screwed onto the fuselage bulkhead.

6 Glue two more slotted maple blocks that have 1-inch-long, 1/16-inch-i.d. brass tubes to the underside of the canopy base so that the blocks ride on the guide wire. The slots are horizontal, allowing the canopy base to be properly aligned with the fuselage canopy platform (Figures 4 and 5). When everything has been aligned, glue the brass tubes into the blocks, working from the wing-mount opening.

7 Once the canopy base has been installed and can slide without binding, glue the canopy onto it, and carefully line it up with the fuselage. Glue the windshield section to the fuselage so that it lines up precisely with the rear canopy. After the glue has dried, add the framework and rivet details, and paint the canopy. Drill a hole through the aft end of the canopy and the aft flange of the canopy platform, and glue a pin into the hole in the aft end of the canopy. The pin can then slip into the hole to lock the canopy closed for flight. It's very simple. Now your model is ready to earn more points in static judging, and it will look and function more like the real thing.

**Here are the addresses of companies mentioned in this article:*
***Mighty Lite;** distributed by Frank Tiano Enterprises, 15300 Estancia Ln., W. Palm Beach, FL 33414.*
***Zap;** distributed by House of Balsa Inc., 10101 Yucca Rd., Adelanto, CA 92301; Robart Mfg., P.O. Box 1247, 310 N. 5th St., St. Charles, IL 60174; and Frank Tiano Enterprises.*
***Bob Holman Plans,** P.O. Box 741, San Bernardino, CA 92402.*

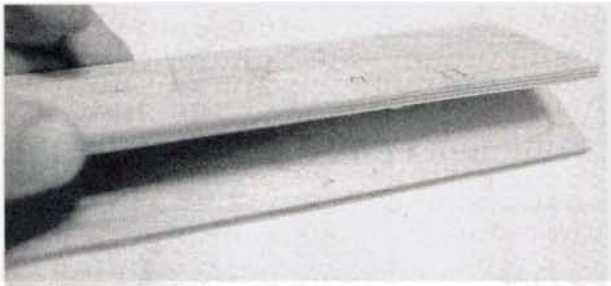
by RUSS PRIBANIC

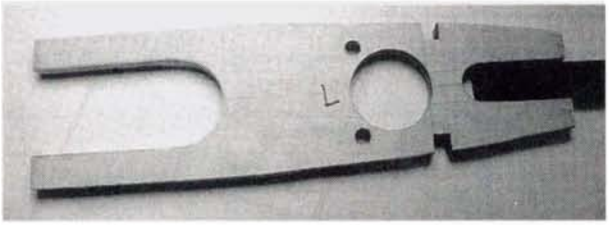
AFTER I HAD been to several gas fun flys and had seen models such as the Stickit and the Smith Special flown successfully, I decided that a similar design engineered around a hot electric motor could be very competitive in glow contests and could set new standards for electrics. I started designing and building this project in July 1991. To keep the all-up weight and construction time to a minimum, I focused on simple construction techniques, and I used as few parts as I could without sacrificing structural integrity.

the WATT?

A fun-fly model for glow or electric

What makes this plane's performance so spectacular is the geared Astro* FAI 15 that runs on 10, 1500mA SR* cells. This motor is so much more potent than the standard Astro 15 that I think it should be assigned a higher displacement number. Although you'll find that duration is reduced when you use the FAI 15, remember that this motor was designed to yank competition gliders to altitude in seconds. I use it with a gear drive and a 12x9 prop, and this combination pulls the model vertical for 2 minutes of raw excitement. Although it was conceived for electric flight, this design has also been built as a successful gas-powered model. I'll describe construction of both versions.





Top: start construction by laminating together two pieces of ¼-inch-thick plywood for the motor mount. It's easier to cut the pieces when they're glued together. Middle: here's the completed motor mount with its engine/motor cutout and the tail boom in place. The tail boom should be glued and bound into place with carbon-fiber or Kevlar thread, or with fiberglass tape. Below: I like to sand the tail parts with a long, flat sanding block. Remember to taper the trailing edges of the rudder and the elevator.

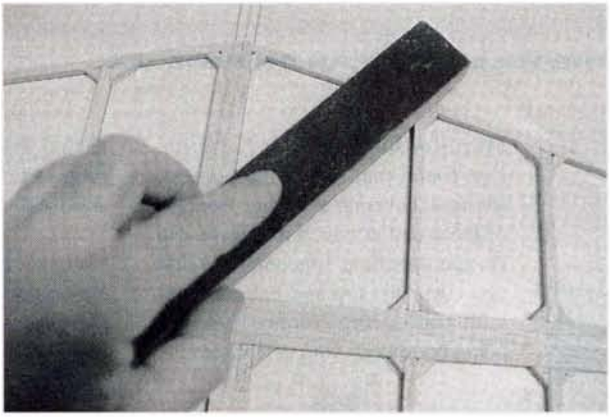
SPECIFICATIONS

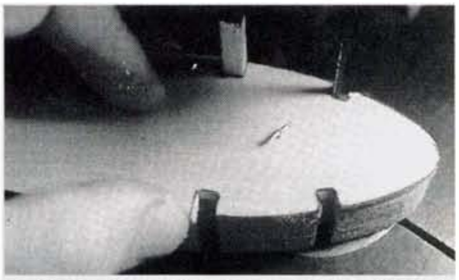
Name: The Watt?
Type: Electric or gas fun fly
Wingspan: 46 in.
Weight: 60 oz. (electric); 40 oz. (gas)
Wing area: 644 sq. in.
Wing loading: 13.4 oz./sq. ft. (electric); 9 oz./sq. ft. (gas)
Power: Astro FAI 15, geared motor (10, 1500mA cells); .25 to .35, 2-stroke engine
Prop: 12x9 or 12x8 (electric); 10x4, 10x5, or 11x4 (gas)
No. of channels req'd: 4 (aileron, elevator, rudder, throttle); 5 for mixed flaps, spoilers, ailerons; 5 servos used.

Comments: designed for fun-fly aerobatic flying, the Watt? uses capstrip construction and built-up tail feathers. The tail boom is a tapered carbon-fiber tube from Aerospace Composite Products. The strong, light model has great vertical performance. You can build it with or without a rudder.

CONSTRUCTION

Before you start fuselage construction, get a tapered carbon-fiber tail boom (part no. TU 11) from Aerospace Composite Products*. Fiberglass kitespar is an inexpensive alternative. Cut your plywood motor mounts out of a ¼-inch ply sheet. I find that it's easiest to glue the two pieces together first, and then cut out the area that suits your motor. For the sake of your thrust line, cut accurately. Using carbon-fiber cord, Kevlar cord, or fiberglass tape, bind the large end of the carbon-fiber tail boom to the plywood motor mount, and saturate the bound areas with CA. (I highly recommend Satellite City* thick and thin UFO.) Now, stand back and admire your finished fuselage!





Above: the easiest way to produce ribs is to stack the pieces of wood so that you can cut them out at the same time on a band saw. Pin or tack-glue the sheets of wood together before you cut out the ribs.

WINGS

Start construction by cutting the ribs. Put the lower ¼-inch square spar on the plan, pinning it on either side of (but not through) the balsa. Keeping your motor mount square with the plans, lay it over the spar and pin it into place. Place the ribs on the spar. (I used a ⅝-inch-o.d. plastic pipe to assist in placement and to support the trailing edge.) Slide in your leading-edge and trailing-edge spars, make sure that everything is aligned, and then glue them into place. Attach the 3/16-inch trailing edge, and, following the contour of the rib, sand it or razor-plane it. Cut two 3/16x4½-inch pieces of 0.007-inch carbon-fiber ribbon. Apply one piece above and one piece below the place where the right and left trailing edges meet the fuselage tail boom, and CA them into place. Install your shear webs now. I recommend that you use them in every bay.

WING SHEETING

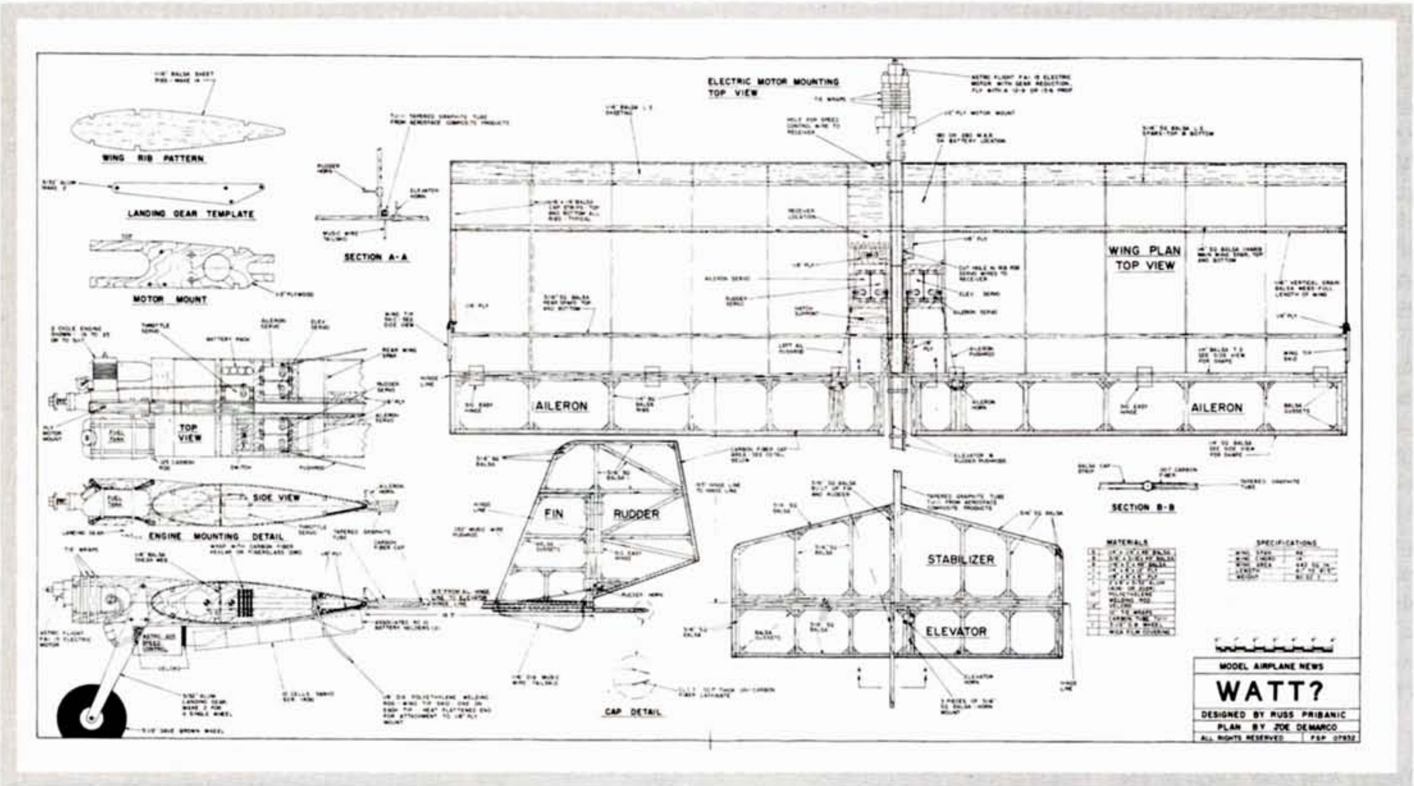
Now that the wing frame has been completed, you can remove the plane from the plans. Make the leading edges out of two pieces of 1/16-inch-thick, 3x23-inch sheeting. First, shape the sheeting by brushing it with household ammonia and curving it around a 1- to 1¼-inch dowel. Give it sufficient time to absorb the ammonia before you form it around the leading edges. Once you've added the center sheeting to the bottom, attach the capstrips and the servo rails. Then mount the center sheeting and the plywood hard points for the motor battery-pack mounts onto the bottom of the wing. Construct the servo hatches, and attach the two plywood tip-skid mounts to the inside of the wingtip ribs, where shown.

AILERONS

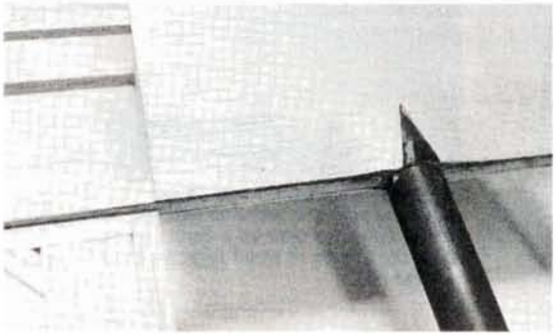
Assemble your ailerons out of ¼-inch square balsa. The gussets are critical, so don't leave them out. To reduce twisting, after I've sanded the trailing edge to a taper, I cap-strip its top and bottom with 0.007 carbon-fiber tape. To build the tail, use the technique that you used for the ailerons, but use 3/16-inch square balsa. Attach the control surfaces with Sig* Easy Hinges. Leave enough of a gap to achieve at least 45 degrees of throw.

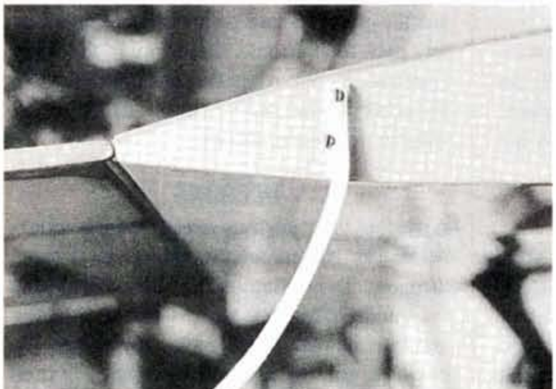
COVERING

I cover most of my planes with Coverite's*



FSP 07932—PRICE $12—ORDER THE FULL-SIZE PLAN ON PAGE 113.





Top: after you've glued the carbon-fiber strips to the trailing edge; glue the center sheeting into place. Note that the sheeting has a notch cut into it at the point where the boom exits the wing. Above: the tip skid is a piece of plastic rod. The end with the mounting screw through it was heated and then flattened.

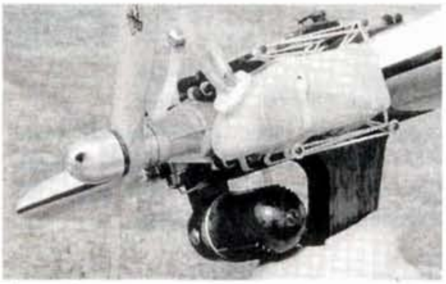
Micafilm stuck on with Balsarite. I've found that this is the lightest, strongest covering available. Because of the speed at which this plane can change direction, I recommend that you cover the top and bottom wing with contrasting colors. This will help you to keep your orientation.

TAIL

To attach the tail, cut away a slot of covering to expose the balsa for gluing. Measure and cut the carbon-fiber tube for the tail boom so that it extends 19½ inches from the wing's trailing edge. Cut the tube with a very fine hacksaw blade or a razor saw. To minimize splintering, rotate the tube continuously as you saw it. Never run your hand along the length of the tube. Its splinters are much more painful than those from wood, and they can be dangerous. Roughen up the bottom and the left side of the tube. Apply 15-minute epoxy sparingly to attach the horizontal and vertical stabilizers. (Notice a small gap between the vertical fin and the tapered tube. This keeps the rudder in alignment.) Wait at least one hour, and then drill through the horizontal stabilizer and the bottom (but not the top) of the tube. Attach the 1/16-inch music-wire tail skid, and your tail boom is complete.

RADIO INSTALLATION

When you've covered your plane, hook up the control surfaces and install your servos.



The unique trapeze arrangement uses rubber bands and long shafts to isolate the fuel tank from engine vibration. Obviously, this isn't required for the electric version.

I've used Futaba* 3002 servos (with the new, metal output shaft) with great success; they're light, fast, powerful and rugged. The aileron throws should be 1½ inches up and 1½ inches down. If this is your first attempt at a fun-fly design, follow my advice. The elevator will be 1 inch up and 1 inch down, and the rudder (if used) should be all that you can swing. You might still want to reduce these measurements by half for the

first flights. For an airborne battery, I've found that a 5-cell, 6V pack is worth the extra weight. For competition, try a 225AE or 250mA pack. These packs are good for two short flights only. For practice, a regular 500mA pack is adequate.

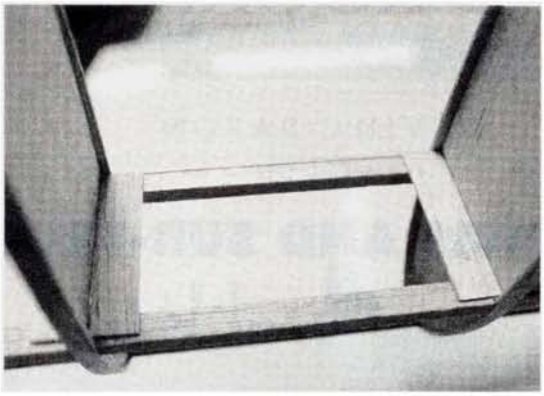
Attach the landing gear to the plywood. Mount the wheel with a 6-32 screw and a locknut. If you can't find a high-quality nut with a nylon lock, then use two conventional nuts and tighten them against each other. Seal them with thin CA.

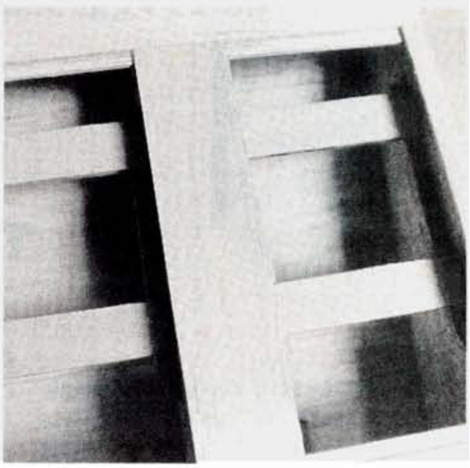
ELECTRIC-POWER INSTALLATION

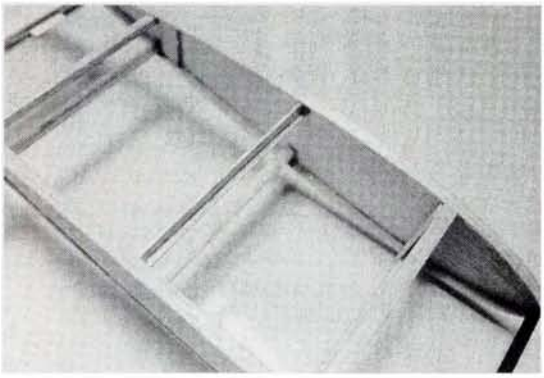
Mount your battery holders, which are screwed into the plywood plates. I used Associated* RC10 battery holders, which I borrowed from my son Justin's R/C car. (He should be flying planes now, anyway.) Attach the speed controller with Velcro® to the forward edge of the front battery holder, between the landing gear legs. The Astro 205 speed controller handles the abuse very well.

Next, install the motor. I use heavy-duty tie-wraps to secure it to the mount.

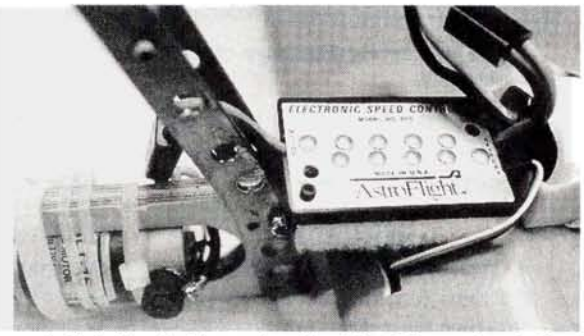
Attach a 12x9 or 12x8 prop. I've had excellent results with Master Airscrew* wooden blades. Recheck your control surfaces for proper direction, and check the CG. Now you're ready to fly and have some fun!

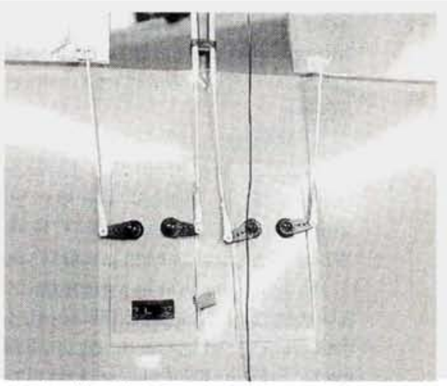






Above left: thin strips of shear webbing increase the strength of the wing and stiffen the ribs. I suggest that you include them all the way to the tip rib. Above right: the wing's top sheeting includes two radio-hatch cutouts. Here, you can also see the thin, plywood servo rails installed in the radio compartment. Left: the wingtips are reinforced with thin strips of balsa and carbon fiber that have been laminated together. These prevent the tip rib from pulling in when the covering is tightened.





Left: in the electric version, the Astro 205 speed controller is attached just in front of the battery holder on the bottom side of the wing. Right: the control arms are the only exposed parts of the servos. As shown here on the finished model, the hatch covers are secured with tape.

GLOW-POWER INSTALLATION

The Watt? can be flown with an engine in the .25 to .35 range; I've had good results with the Enya* .35 SS heli engine with a modified (turned-down) heli cylinder head. The engine of choice for this plane is the Webra* .32 with the Dynamix carb. Although it looks unusual, this carb has a better throttle response than that on any engine I've ever used. Use your own engine as a guide to drill the engine mount for the mounting screws. Install a 4-ounce fuel tank if you plan to sport-fly, or 2-ounce tank if you want to try your hand at competition. The plan shows a "trapeze" tank-mounting system that minimizes fuel foaming. For a low-cost alternative to the carbon-fiber, fuel-tank mount rods shown on the plans, you can use a polypropylene welding rod (available at any plastic supply shop).

In the last few KRC Electric Fly competitions, this design has captured first place in both loops and barnstorming and second place in rolls. No other aircraft has come close to this feat in all three events.

PROVEN DESIGN

In the last few KRC Electric Fly competitions, this design has captured first place in both loops and barnstorming and second place in rolls. No other aircraft has come close to this feat in all three events. This plane has rewarded me with many trophies and prizes in both electric and glow-powered contests. Even in gas contests (with electric power), it has managed a very creditable sixth place in a field of glow, fun-fly models. I think that you'll enjoy your Watt? no matter how you power it.

**Here are the addresses of the companies mentioned in this article:*

Astro Flight Inc., *13311 Beach Ave., Marina Del Ray, CA 90292.*
SR Batteries Inc., *Box 287, Beuport, NY 11731.*
Aerospace Composite Products, *P.O. Box 16621, Irvine, CA 92714.*
Satellite City, *P.O. Box 836, Simi, CA 93062.*
Sig Mfg. Co., *401 S. Front St., Montezuma, IA 50171.*
Coverite, *420 Babylon Rd., Horsham, PA 19044.*
Futaba Corp. of America, *4 Studebaker, Irvine, CA 92718.*
Associated Electrics Inc., *3585 Cadillac Ave., Costa Mesa, CA 92626.*
Master Airscrew; *distributed by Windsor Propeller Co., 3219 Monier Cir., Rancho Cordova, CA 95742.*
Enya Model Engines, *P.O. Box 286, Fords, NJ 08863.*
Webra; *distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821.*

SIMPLE PROGRAMMING

DAVID C. BARON

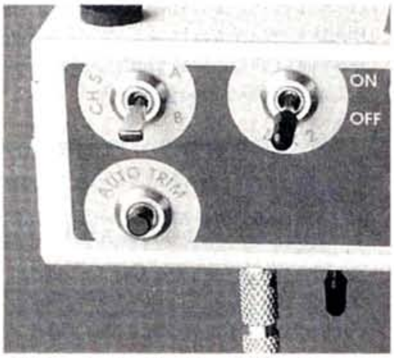
TRIMS AND SUB-TRIMS

FROM THE size of the "Simple Programming" mailbag, it seems as if we're stimulating a lot of interest in our readers. Many are finding that, as they start to understand their radios better, they have even more questions about using them. I encourage all "Simple Programming" readers to send in their questions and comments to me, c/o "Simple Programming," *Model Airplane News*, 251 Danbury Rd., Wilton, CT 06897. No questions are unimportant. If I get enough inquires about a common problem, I'll cover it in a future column.

Al Munger of Poulsbo, WA, writes to ask that I explain the difference between the "sub-trim" and the "auto-trim" functions on his Futaba* 7UAPS. When and where is each properly used?

Al, your question is a great one, and it's easy to understand the confusion. This question deserves to be applied to every radio in the field, so I've chosen four radios to cover all the bases. I'll start with an explanation of each of the electronic trims, and then I'll describe how to use them. I've numbered the definitions below so that, as their names change, with the different radio types, my definitions won't have to be repeated.

The Ace MicroPro 8000 single-stick radio is now here.



Unique to the MicroPro 8000 radio series is the auto-trim button. Will this innovation pave the way to transmitters that don't need manual trim levers?

DEFINITIONS

1. **Trim memory or sub-trims.** This is the radio function that allows you to fine-tune the neutral position of your servos. This is useful in situations where you might need to achieve perfect centering of your servo's output arm, but moving it on the splined output shaft would create too much of a change. This function is used most often during radio installation.

2. **Auto trim.** This is designed so that you don't have to re-trim your model each time you jump from one memory to another. Do this for each model in your transmitter's memory. As long as the transmitter's mechanical trims are in their neutral position, you'll be able to switch between models without any of them being out of trim. Ultimately, you need only check that your transmitter trims are at neutral before flight.

For the sake of those who own other brands of radios, I'll briefly cover each radio's unique characteristics. Note that each manufacturer calls the functions by different names.

ACE* MICROPRO 8000

1. **Neutral position.** Ace's unique approach to servo centering shows its value in microseconds. In most applications, this would stay at 1.50 microseconds (1.31 microseconds, if you're using Futaba G servos).

2. **Auto trim.** This unique trimming feature is the only one on the market designed to be used "in flight." If your aircraft is out of trim and level flight is possible only with the sticks deflected from neutral, then simply press the "auto-trim" button on the top left of the case. While the button is held, the servos slowly move in the direction of the stick deflection. Soon, you'll feel the plane begin to overtrim, and because of this, you'll slowly move the sticks back to neutral. With the sticks in neutral, the plane will be trimmed out, and you can release the button. The transmitter will save the trim values. Remember to press the "auto-trim" button only when you hold the plane in level flight!

AIRTRONICS* 660

1. **Center.** This function allows you to vary the center of each of the four basic channels from 0 percent (normal), to +/-100 percent.

2. **Trim memory.** This function allows you to save the trim settings of the four basic channels as neutral. You can save them individually, or, by selecting "ALL," you can save all the channels simultaneously. After you've stored a trim value in the memory (by pressing the "YES/INC+" key), you must turn off the transmitter and re-center the manual trims. When you turn the radio back on, the new trim settings will be in

place. Note that, in the display, you can read the percentage that the trim has been displaced.

FUTABA 7UAPS

1. **Sub-trims.** These are available on all seven channels. You can manipulate the center from a normal of 0 percent to +/-100 percent.
2. **Trim.** To use this feature, you would first fly your model and set the mechanical trims on the transmitter for elevator, aileron and rudder to achieve smooth, level flight. After you've landed, go to the trim function and press the two "Data Input" keys simultaneously. This causes the radio to "memorize" the position of your mechanical trims, and it makes the proper corrections so that you can return the mechanical trims to the neutral position.

As with most single-stick radios, there are many switches on the side of the transmitter case. Notice the auto-trim button near the top of the side.

JR* X388S and X347

1. **Sub-trims.** This electronic trim works on all your radio channels. It gives you a range of +/-125 percent. This represents about 30 degrees of servo travel.
2. **Trim memo (X388S only).** When you're in this function, be sure that your manual trims are set where you want them for level flight. Activate the function by pressing either of the data keys. The display will now read "TRIM MOV.T." This display prompts you to re-center the manual trims. Once this has been done, press the "Store" key and the display will change to "TRIM MEMO." This tells you that the current trim values have been memorized.

CONTROL TRAVEL

Most of the auto-trim and trim memory functions share a range of 15 degrees of servo throw on either side of center.

If more throw is required for trimming, you must make a mechanical adjustment to the control linkage.

Keep in mind that if you use 15 degrees of trim displacement from center, you take away 15 degrees from the servo's ability to reach its maximum deflection in that same direction. When possible, it's always best to make the appropriate mechanical changes to the pushrod so that you can reset all trims to "0" and, once again, enjoy equal proportions of throw in each direction.

I just received the new JR X388S 8-channel computer radio, and I must say that it looks like a winner. We'll take a closer look at this new radio in a future issue. Until then, keep those cards and letters coming in.

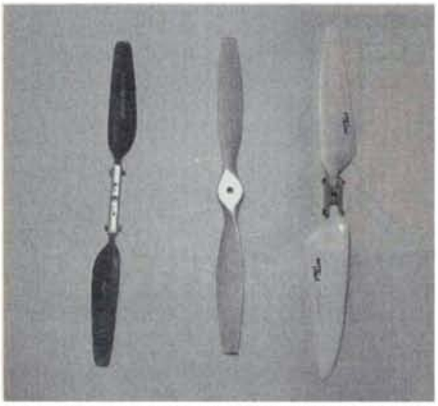
**Here are the addresses of the companies mentioned in this article:*
Futaba Corp. of America, *4 Studebaker, Irvine, CA 92718.*
Ace R/C Inc., *116 W. 19th St., Box 511C, Higginsville, MO 64037.*
Airtronics Inc., *11 Autry, Irvine, CA 92718.*
JR; *distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821.*

How To Fly Your Propeller

by TOM HUNT

Dynamic thrust testing sheds new light

CHOOSING A propeller for an engine or an electric motor on a sport or scale model can be rather subjective. The modeler usually starts with the manufacturer's recommended prop and then varies the diameter and/or pitch until the engine or motor sounds right, or the airplane flies right. Long experience—either yours or a fellow modeler's—may also decide the question. We, the sport modeling community, have been doing this for more than half a century, and no computer program or manufacturer's claims are going to change that. For flight performance to be acceptable, good, outstanding, or competitive, the propeller must be matched to the powerplant, airframe configuration and the "mission" (its intended use)—all at the same time. A model aircraft is a "system," not just a motor and propeller stuck on the front of something that will fly! That system must be well integrated if the airplane is to perform its mission as expected.



The three props tested included a Master Airscrew 12x8 (left), a Zinger 12x10 (middle) and an Aeronaut 14x8.5 (right).

What is your model's mission? Whether it's a trainer, sport airplane, scale model, sailplane, pylon racer, seaplane, or aerobatic, it must have a properly tuned system to be successful or competitive.

Matching the proper engine to the airplane is the kit manufacturer's job, and the *initial* match of the propeller to the engine is the engine manufacturer's job. Once the modeler defines the airplane's mission, the system can be tweaked. Choosing the right propeller is the least expensive way to fine-tune the system.

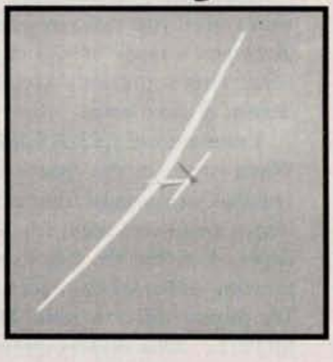
Propellers, as you well know, come in many different shapes and sizes and from many manufacturers. There are "true" pitch propellers, constant pitch propellers, fixed angle, helical pitch, varying pitch propellers, wide blade, extra-wide blade, scimitar and more. The differences between these propeller types are beyond the scope of this article.

This discussion will, however, try to provide the reader with a few basic propeller performance insights that are not often addressed in the modeling literature. These insights were gained through the testing of the thrust of several propellers under static and wind-tunnel conditions. Testing was performed at the Grumman Low Speed Wind Tunnel on Long Island, NY, where I work. The tests were intended to assist in the selection of the most competitive propellers for use in sprint-class electric-powered sailplane events (AMA Class A, B, SAM Old Timer Electric LMR, etc.). These events are very demanding in terms of propeller performance. The lessons we learned reveal interesting characteristics of the propellers tested, and they also provide insight into the value of learning to fly your selected propeller well.

MISSION PROFILE

Before you choose a new prop, you must first fully understand the mission of the aircraft. In the sprint electric-soaring events, the competitor is given a short amount of time to climb as high as possible. The motor is then shut down for the gliding portion. The mis-

The Myth



sion can best be described by looking at a specific event. For example, the Class A electric-sailplane event allows 45-second motor runs on any motor using a maximum of seven cells. Flight times of 8 minutes are expected for maximum points. A spot landing may or may not be required. The requirements for these events are so few that a wide variety of airplanes can be used. Built properly, they weigh between 38 and 54 ounces, and they are powered by various types of 05 ferrite and cobalt motors (usually gear driven with a ratio between 2.2:1 and 3.0:1). The battery packs typically used range from 800 to 1,400mAh.

Experience tells us that to obtain 8-minute-flat air flights (no sustaining thermal lift) with these types of models at the *lower* wing loadings requires 1,000 to 1,200 feet altitude at the end of that 45-second motor run. The dotted line in figure 1 shows how fast you would have to fly to get there in 45 seconds, assuming *no* battery degradation! This flight path assumes both airspeed and climb rate are constant. This information alone could help you choose the proper pitch propeller to complete the mission. However, carrying a large enough (and proportionately heavier) capacity battery pack to fly the ascent at a constant rate of climb (notice I didn't say speed), would penalize the glide too much, which is a substantially longer portion of the flight.

Popular models for this event are Spectras, Electras, Eclipses and other converted two-meter sailplanes.

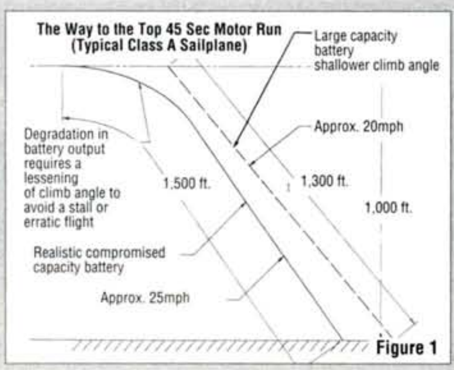


Figure 1

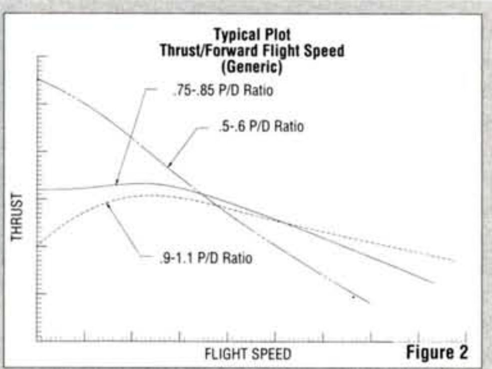


Figure 2

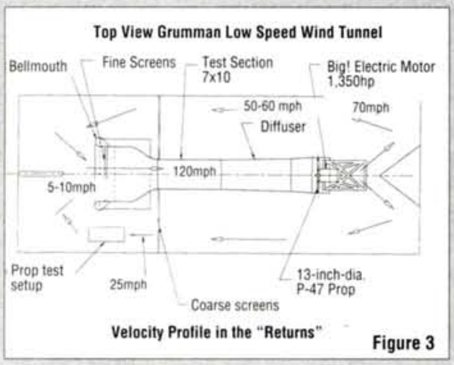


Figure 3

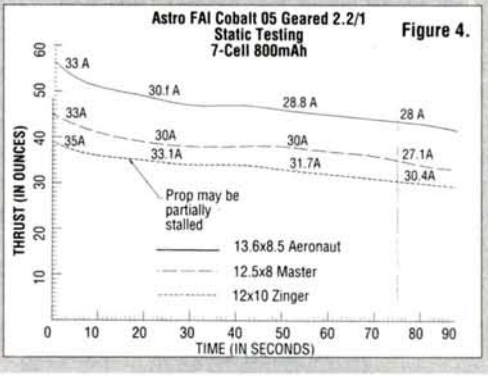


Figure 4.

A typical flight profile for the minimum required battery capacity would look something like the solid-line curve in figure 1. Here, air speed and climb rate vary. Somewhere in-between the dotted and solid lines is the "optimized compromise" flight profile (not shown). What in the world do you mean by that, Tom? As I will show below, it is not *which* propeller you choose that will make you a winner, but *how* you *fly* the propeller you choose that counts. This will optimize your mission and give you a better chance at putting you into the winner's circle.

THE GROUND TESTS

To develop a scientific way to pick a propeller (without doing a lot of math), you need test data. Static testing of propellers (bench testing) only tells us about the properties of the propellers at rest (i.e., without forward motion). In a static test, propellers are most efficient (highest thrust for lowest rpm). However, if the pitch/diameter ratio is

There is—and probably will always be—the belief (among fliers of electric-powered aircraft) that he who draws the most current and swings the prop the fastest will win! This, however, couldn't be further from the truth. There is also the misconception in the modeling community that revolutions per minute—rpm—fly airplanes. Thrust flies airplanes. The following scenario occasionally happens at the flying field. The story will help illustrate why propeller performance is just as important as motor and airframe performance. The names have been changed to protect the guilty!

Sunday morning at the flying field, Joe Sunday is flying his sport airplane with his old faithful motor and prop and has no idea what rpm the prop turns on the ground. Sam Saturday shows up a day late and suggests that his airplane might fly better with a different propeller. Sam is smart enough to have his tachometer with him and suggests that they tach the old Brand X prop with a fresh battery pack. He obtains a reasonable rpm reading (because he is at the field, a current reading is not easily obtainable, so is foregone). The propeller is switched to Brand Y (which has the same diameter and pitch values) and he tachs the motor again. Sam and Joe are astounded at a net increase in rpm.

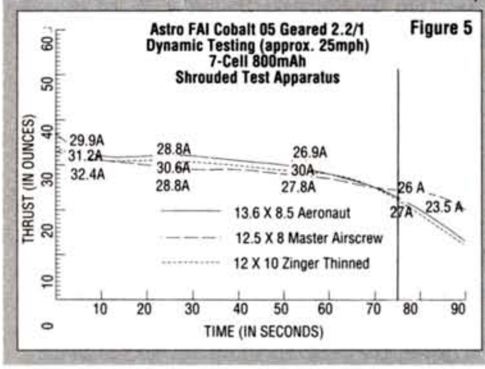
They proceed to fly the airplane with the Brand Y prop, but observe no noticeable increase in speed or duration. If there was an increase in rpm on the ground, why didn't the airplane fly faster in the air? The Brand X and Brand Y props both have the same pitch and diameter. Ah! But they have different blade areas and airfoil cross sections. A prop is nothing more than a rotating wing and we all know the effect wing area and airfoil shape can have on the lift of the wing, don't we? There are good wings, not so good wings, good airfoils, not so good airfoils (for a given mission!). The same is true about those small rotating wings we put in front (or behind) our models.

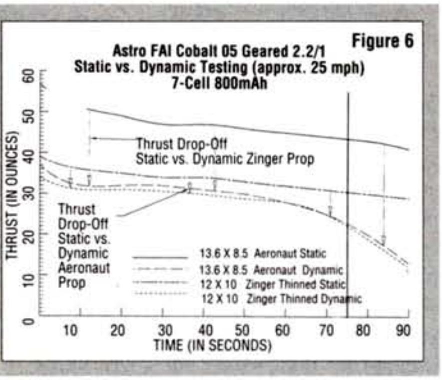
If you are a competitor, just changing to the next prop you see that seems to offer some advantage based upon rpm is not wise. Moreover, trial by fire (competition) is not the way to find out that the new prop was the wrong one!

too high (above .8), then the propeller may be partially or fully stalled as it spins. (For purposes of comparison, a 12x7 prop has a pitch/diameter ratio of .58, and a 12x12 prop has a ratio of 1.) Since static tests of these high-pitch-to-diameter ratio propellers can yield erroneous results (e.g., high rpm, high current and low thrust), propellers should not be discounted based on static testing.

As a propeller moves through the air, the thrust it produces tends to drop considerably. As this takes place, advantageously, the propeller draws less current from the motor. If a prop is stalled statically as it first begins to move through the air, thrust may increase before falling off.

The shape of the curve of thrust plotted against forward speed (Figure 2) tells us the most about the characteristics of the propeller. This graph was left generic to illustrate trends, not absolutes, since exact figures are hard to come by.





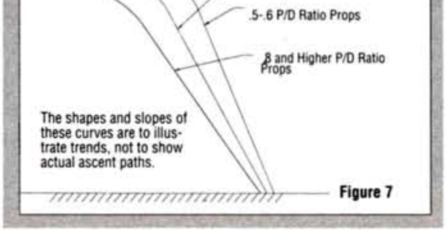
Since I did not have the luxury of testing many props at many different air speeds to get all the data I wanted, I simplified my analysis. I computed how fast my model would have to travel to get to 1,000 feet in 45 seconds using the realistic flight path shown in figure 1. I used that value of forward velocity (25mph) to dynamically test a series of propellers (that had previously been tested statically) in the "returns" of the Grumman Low Speed Wind Tunnel where I work. [Author's note: returns refers to that part of a closed loop wind tunnel, outside of the area of test, that allows the air to "return" to the front of the tunnel.] Figure 3 shows where my test apparatus was mounted in the returns.

TEST STAND

The photo on the following page shows the test setup I constructed to test an Astro

The author's Gentle Lady has been flying for almost 10 years.

Flight* cobalt FAI 05 motor geared 2.2/1 statically (bench testing, no on-coming wind) and dynamically (wind-on) in the Grumman Low Speed Wind Tunnel. The design of the thrust unit is elaborated beyond the one Joe Beshar published in the September 1991 *Model Airplane News*. It utilizes a swinging platform (on four legs as opposed to Joe's two) connected to a 10-pound digital fish scale (by Normark Electronics*) by a simple pull string. This unit claims an accuracy of plus or minus 1 ounce over its 10-pound range, and I have found it to be at *least* that accurate and repeatable in all the testing I have done. A clear plastic shroud encloses all but the prop shaft so that the propeller blast and the oncoming wind does not impose a load onto



the apparatus measuring thrust.

Various propellers that have been reported to be winners by knowledgeable people in my electric club were first tested statically on this apparatus. The photo on the opening page shows three of the most popular and efficient props tested. The Master Airscrew* 12x8, on the left, (it actually measures 12.5 inches diameter on the hub supplied) was modified by removing the blades from the hub and substituting various homemade hubs that varied pitch and diameter. It is shown in its original 12.5x8 configuration. The Aeronaut* prop (right) comes stock labeled as a 14x8.5 (it actually measures 14.2 inches in diameter). The folding blades were mounted on various hubs in the search for optimal performance. The Aeronaut propeller is shown mounted on a modified Sonic Tronics* hub, which produced a diameter of 13.6 inches. This was found to be optimum. *[Editor's note: we strongly discourage readers from modifying or swapping out prop hubs. Master Airscrew, Aeronaut and Sonic Tronics do not endorse such modifications, as they can cause safety hazards.]*

The Zinger* 12x10 (middle in photo) was first tested stock. It performed so poorly statically (probably because it was fully stalled), I almost threw it right in the garbage! I decided to thin the prop by undercambering and sanding the top slightly. Static performance improved tremendously. [*Editor's note: Zinger does not recommend or endorse that these props be so modified, nor does Model Airplane News. This modification was performed by the author, a Grumman aerospace engineer, for electric flight purposes—where the rpm are significantly lower than in glow-powered flight.*]

Thrust and current were obtained and plotted against time for many more propeller configurations than are depicted in figure 4. All the data I took for just these three props (and their many variants) could fill a book! Maybe someday, 30 to 40 years from now, when I'm retired, I'll write that book! The tests were repeated in the wind tunnel returns at an approximate forward velocity of 25mph. That data is shown in figure 5. An overlay of the two data sets (static vs. dynamic), figure 6, tells us more about these

propellers than a thousand flights ever could!

THE GROUND TEST RESULTS

Surprisingly, the propeller that produced the most thrust statically (Aeronaut 13.6x8.5) was not significantly better dynamically, i.e., at 25mph, than a statically poor thinned Zinger 12x10 (probably because it was partially stalled) at the same forward velocity. That is, the Aeronaut propeller lost a whopping 33 percent of its thrust at 25mph! The Zinger prop only lost 15 percent of its thrust at 25mph and had a similar power degradation over the test period (90 seconds). If you had only the static test data as a basis to choose a propeller, you might well overlook a propeller that would be comparable or even better at flight speed. At face value, after looking at the dynamic performance of these propellers, either might do the job.

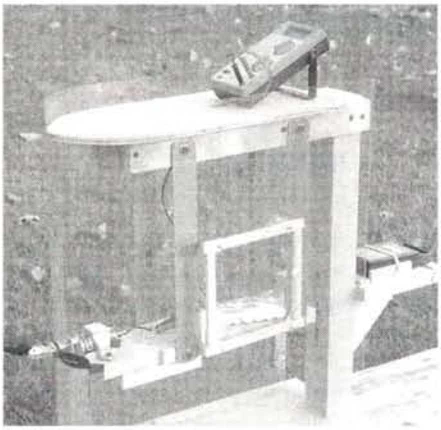
The higher drag of the Zinger non-folding propeller would tend to cancel any altitude gain that it might achieve over a folding prop. However, it is no surprise that the Zinger 12x10 is the prop of choice (by many seasoned fliers) for the LMR SAM electric OT events—which do not allow the propeller to fold.

THE FLIGHT TESTS ("FLYING THE PROP")

Flight testing propellers must be done on aircraft for which the flight properties (maximum rate of climb at a given wing loading, handling qualities, etc.) are already well known. This ensures that when different propellers are tested on the vehicle, the pilot can pay more attention to what may have changed, instead of spending all of his brain power just flying the airplane. The three propellers tested were flown on my Kerswap Old Timer and my electric converted Gentle Lady. I have logged dozens of flights on each of the aircraft in and out of competition. (My electric Gentle Lady is almost 10 years old and has seen many a different motor and propeller on it.)

On absolutely calm, cool early mornings the models were sent aloft to compare the climb performance. It was found that in calm conditions, the Aeronaut won hands down, the Master Airscrew came in a close second and the Zinger came in a miserable third. When the wind came up over 5 to 10mph, the difference in climb rate between the props was less noticeable. When the headwind reached higher levels, above 15mph, the prop performance reversed. The Zinger outperformed the Master Airscrew and the Aeronaut came in a miserable third! What happened? From our previous knowledge of propeller performance in the wind tunnel, the Aeronaut propeller wants to travel at a slower speed in the ascent to keep its thrust value high. This requires a steeper ascent. The Zinger likes to go fast to optimize its thrust level. The Master Airscrew is somewhere in between the two.

When the wind is calm, or non-existent (how often does that happen at contests?!),



This test stand was used for both static and dynamic (wind-tunnel) testing. A swinging platform with power-system components is suspended from four legs.

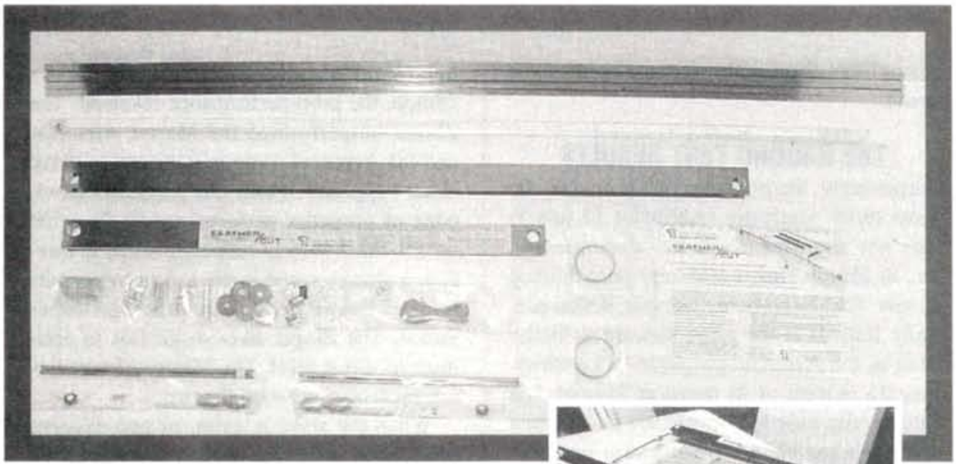
the airplane can be flown more vertical to reach altitude. That slows the airplane down and makes the Aeronaut a more efficient choice (see figure 7). As the on-coming wind builds, it is not desirable to climb as steeply, because the aircraft is more susceptible to gusts, causing the flight path to become erratic, wasting altitude and time. Another advantage of a shallower climb in windy conditions is that it allows you to be much farther up-wind after motor shutdown, so you can look for thermals on the way back over the field. The higher forward speeds desirable during windy days favor the selection of the Zinger prop. The Master Airscrew prop is a good propeller to learn on because it tolerates a larger speed range for good climb performance.

CONCLUSIONS

So, what have we learned from all this? If

(Continued on page 80)

PRODUCT
REVIEW



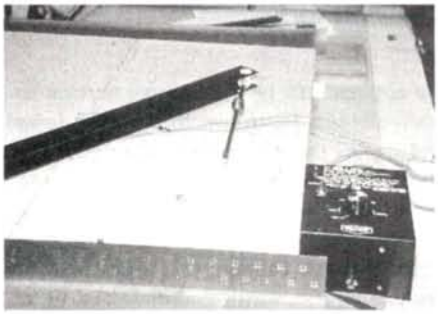
The parts are shown right out of the box (above), and fully assembled with power supply and manuals. To use this foam cutter, just tape the long piece with the rollers to the edge of the workbench.

Feather Cut Hot-Wire Foam Cutter

A hands-off system for quick, accurate foam cores

by MICHAEL LACHOWSKI

THE FEATHER CUT system by Tekoa* is a well-thought-out, hot-wire foam-cutting system. It cuts foam-cores for wings and tails. Since the system is fully automatic, it is easy to learn how to cut good cores without a lot of practice and wasted foam. Of course, you still need good templates to get a good core.



The rods on the bow fold back into the aluminum channel. Hot wire is attached to caps that slide on and off the end of the bow rods. This makes it easy to set up the hot wire and remove the wire.

Assembly is easy, and it takes 1 to 2 hours. You will need some masking tape and a few common tools. The most complicated part is bending a simple curve into the wire that holds the small wheel on which the bow rides (although it's a minor issue given the overall quality of the system and its price, this simple piece of wire gear really should be pre-bent). The price of the Feather Cut plus Thermal Generator is $234, and I added a second, larger 40-inch bow that brought the total to $263.50. You should consider making this a club purchase to spread out the cost, unless you cut plenty of cores.

Everything for the cutter arrived in a heavy cardboard tube. The pieces of the cutter and bow are packed in plastic bags. You must assemble it, so spend some time reviewing the 15-page instruction manual before you start. I started by assembling the bow, which is an aluminum channel and two pivoting spring rods. The rods pivot on large Delrin bushings that allow the bow to fold for storage. Note that sketch B for the wheel attached to the bow is not full-size. Aside from this minor point, the instructions are good.

One great idea on the bow is the cap used to attach the hot wire. The hot wire wraps around two caps, not around the spring rods. This makes it easy to wrap the wires without any tension at the prescribed length. Once wrapped, slip a cap on the end of one rod,

SPECIFICATIONS

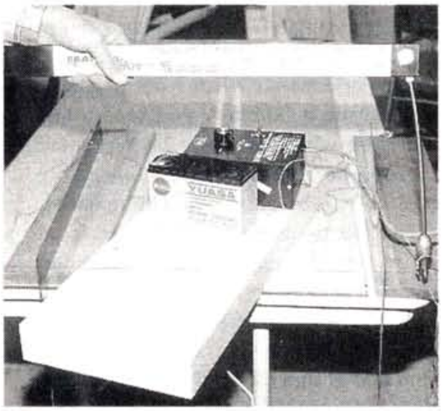
Feather Cut hot-wire foam-cutter kit: $139.50
Comments: the standard kit includes a detailed, illustrated instruction manual, a 28-inch bow and 8 feet of hot wire. (The bow and the hot wire are also available separately—$24.50 and $3, respectively.)
Also available: thermal generator—$94.50; 40 in. bow—$29.50; 52 in. bow—$34.50.

and press the spring rods so the second cap can slip on to complete the wire installation. It's easy to remove the wire, too. An operational checklist attached to the bow is helpful when you're using your Feather Cut.

The next step is assembly of the Feather Cut body. There are plenty of parts to assemble, so familiarize yourself with the parts and sort out the pieces for the horizontal and vertical rollers before you start. The sketches are a big help here. Don't overtighten things at this point, since all the rollers get moved when you set up for cutting.

POWER SUPPLY

If you don't have a power supply, the Thermal Generator is a good addition, especially when it's used with Tekoa's T-370 cutting wire. The Thermal Generator is complete; all you need to do is attach the



You can easily cut foam-core blanks by drawing the wing planform on the foam and then cutting the foam using two squares hanging over the edge of the table as cutting guides.

crimp connectors to the pull wires on the Feather Cut. This power supply includes an on/off switch, a dial to set the wire temperature and a meter. By adjusting the meter to the middle of the scale, you will have a good temperature for cutting most foams. As you gain experience, you will learn how to fine-tune the temperature to control cutting speed and the amount of foam the wire melts. The meter is calibrated specifically for the T-370 cutting wire provided by Tekoa (you'll have to experiment when using the meter with other types of wire).

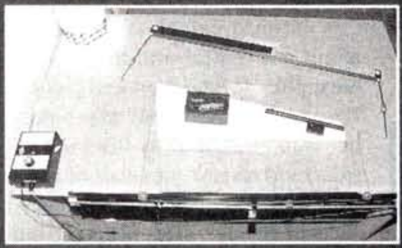
LET'S CUT SOME FOAM

The first step is to prepare the blanks for cutting. As guides to cut the foam, I use two squares hanging off the edge of a table. Because of the channel shape, I find holding the fold bows uncomfortable. The balance weights add to the weight of the bow and make it feel heavy. I've gone back to my lightweight wood bows for foam cutting. Check out note 9 in the instructions for ideas on building your own bow.

If you have your airfoil templates, you're ready to cut some cores. I attach the Feather Cut body to one of my worktables with some masking tape. Make sure you clear off the work area so there are no obstructions during cutting. A 14-step checklist for cutting cores is printed on a label on the bow. Besides good templates, the most critical part is adjusting the pull cords and pulleys for the wing taper. Since one end of the core is wider than the

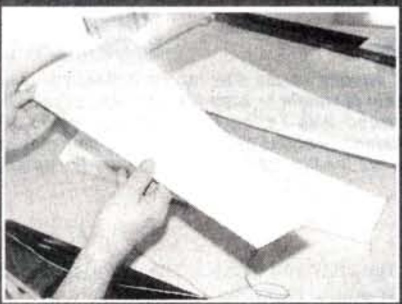
Reader's Report

By Tom Atwood



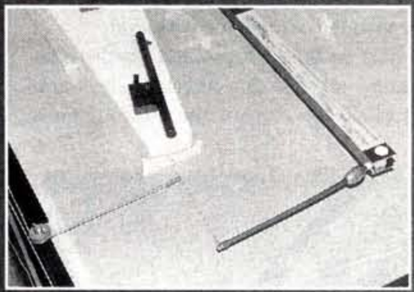
The Feather Cut can be set up on any convenient worktable in only a few minutes. Here, I am cutting foam-cores for a 70-percent version of the original Klingberg wing from Future Flight.

Since I had no experience cutting foam wings, I was eager to test the Feather Cut to see if cutting high-quality cores was as easy as it had appeared in demonstrations I had seen at trade shows. The instructions for setting up were clear and helpful. They include supplementary airfoil and planform suggestions for scratch-building a thermal sailplane—a nice touch for the non-expert. Some care must be taken in getting the wire between the bow rod end caps the right length, so that when you string the bow, the tension is correct.



The foam-core looks good. A final trim cut was made along the leading edge and then the wing was sheeted with 1/32-inch balsa sheet and a leading edge balsa strip was added. This was much faster than constructing a built-up version of the wing.

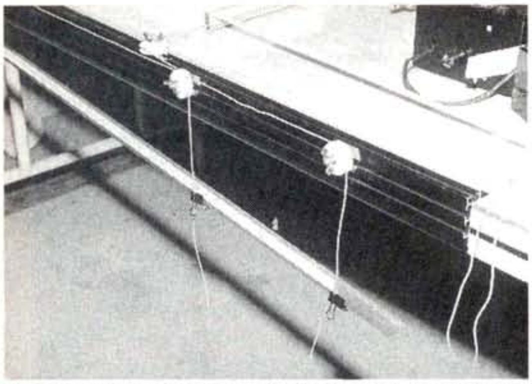
I decided to cut some foam-cores for a 70-percent version of the original Klingberg wing. The Feather Cut instructions show how to build a pivot for one end of the bow if the tip end of the core is less than 40 percent of the root end. Although the Klingberg wing exceeds that taper limit, I was working with white-bead foam (very low density) and took a chance on the standard setup using two pull wires. The Feather Cut worked perfectly the first time. The tips on this wing have significant washout, but this posed no problem.



The Klingberg wing has significant taper and washout. The Feather Cut had no problem cutting first-rate cores from the white-bead foam.

After cutting a few cores, I did encouter a momentary sticking of the hot wire at the outset of a cut. This can cause a lengthwise groove in the core at the beginning of the cut. Cleaning the wire before a cut, or flicking a bow rod with your finger after turning the power up at the start of a cut, will prevent sticking. I made templates from Formica sheeting that I purchased from a local building supply store. This was the most labor-intensive aspect of cutting the cores. The Feather Cut worked as advertised. I found that a relative beginner in foam scratch-building could produce high-quality foam-cores with ease.

HOT WIRE FOAM CUTTER



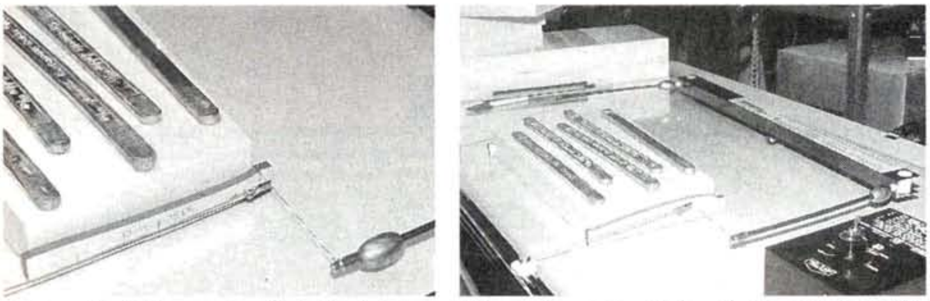
The pull wires, which also supply current to the hot wire, are shown anchored to the graduated control arm. These anchor points determine the relative travel of the ends of the hot wire (important for cutting tapered wings). Make sure the numbers are correct when you anchor the wires.

other, the wire on the narrow end must move slower than the wire on the wide end.

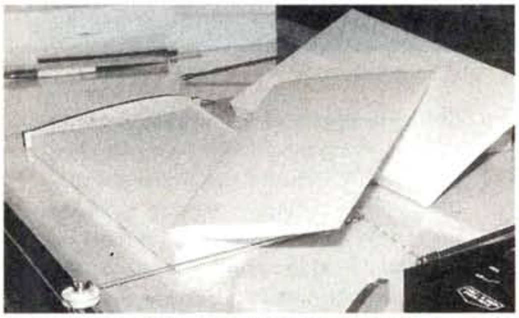
To help in this process, the Feather Cut mechanism includes a weighted control arm that rotates down from the edge of your building surface. The arm has a scale marked from 0 to 100. The pull cord for the wide end of the wing core clips on at the 100-percent mark. The pull cord for the narrow end of the wing core is anchored inboard on the control arm at a distance you calculate. This results in a differential pull to ensure that the hot wire cuts through both ends of your tapered core in the same number of seconds.

You must calculate the distance along the control arm to the attachment point for the short-end pull cord. Because the pull cords clip onto the hot wire an inch away from the wide (root) and narrow (tip) ends of a given core, a final adjustment is needed to account for this extra distance, but it is easily done. This extra inch at each end means that the pull cord pulls the hot wire a slightly greater distance than the chord width on the wide end and slightly less on the narrow end.

To do the calculation, attach the pull cords to the hot wire and place the hot wire (power off) against the leading edge (where it rests before you begin a cut). Put a straightedge along the trailing edge (where the wire will emerge after you make a cut). Now, measure the distance from the pull-cord attachment points to the straightedge. It's easiest to use a ruler graduated in millimeters. Simply calculate the percentage difference between the larger and smaller distances and anchor the short pull cord at this numbered location on the control arm. The instructions provide an example.



Left: cut the bottom surface first. The balance weights are forward on the bow for the bottom cut. This helps keep the cutting wire down on the template. Use plenty of weight to keep the core flat, especially with extruded foams. The templates are laser-cut plywood with Teflon-tape surfaces from LJM Associates. Right: cutting the top surface is done with the balance weights at the back of the bow rods so that less force will be required to pull the bow up and over the leading-edge curves. Be sure the cutting area is clear so the bow travels freely.



Here, I have produced another fine core with no ridges from speed variations during the cut.

The final step is the most important. Lift up the wire so it clears the foam and so that the bow under tension from the pull wires can move in the direction of the cut. Does the narrow end move slowly, and the wide end move fast, without any slack in the pull cords? It really is easy to attach the pull cords in the opposite direction, and you will ruin the core if you do.

I can cut a good core by hand, and I have some experience in which cutting speed to use, so I wasn't too surprised that the Feather Cut cut a good core the first time. If you have a hard time coordinating the cutting rates when you're hand cutting, you will really be pleased with the Feather Cut. I found the greatest improvement when cutting dense foams like blue Dow Styrofoam.

The Feather Cut can handle wing chords of just over 10 inches (including tapers) easily. For wider wing chords or severely tapered wings (where the narrow chord is less than 40 percent of the wide chord), you need to build some extra jigs and fixtures. These are described—complete with sketches—in the Feather Cut manual. The size is limited by the length of the bow and the control arm. With a larger bow, you could cut pieces up to 48 inches long and more than 24 inches wide.

OTHER TIPS

Spend plenty of time making smooth templates. Every imperfection will show up in the core. The Feather Cut does not overcome imperfections. When I put a scratch in a template, it faithfully produced a line in the core where the wire melted some extra foam because it stopped momentarily on the scratch. A good template material, such as the paper-based phenolic from Weston Aerodesign*, is easy to cut and polish to a smooth finish. Avoid any materials with fibers, since you will never get them really smooth. For wood templates, Teflon tape is super for providing a smooth surface and even covering a few blemishes in the template. If you want to avoid the whole template-making process, you can obtain top-quality laser-cut wood templates (with Teflon tape) from Lee Murray (LJM Associates*).

Clean the cutting wire. Foam hair does accumulate on the wire, particularly when the wire exits at the trailing edge. Melted foam hardens on the wire and results in lines in the core running from the leading edge to the trailing edge on the next cut. Don't overheat the wire under tension to burn off the foam. Use a solvent such as lacquer thinner to dissolve the foam and clean the wire.

Clean your work surface. The Feather Cut travels on a tracking wheel, and any junk that gets in its way will change your cutting speed. Check to be sure the ends of the bow will be clear for the entire cut. Watch out if your bottom cut is within ¼

(Continued on page 94)

THE NEW ROBART

4-Stroke Radial

by STAFF

Scale Jacobs debuts at Toledo

AT THE APRIL '93 Toledo Show, many new products were introduced (see some of these in "Air Scoop" in this issue), and several of these products represented years of development work. Perhaps the most notable in this category was the new radial engine from Robart*. When you hear the unmistakable sound of a radial engine running, it's easy to understand why so many aviation enthusiasts—not only AT-6 Texan, F8F Bearcat and the F4U buffs—have a love affair with this type of powerplant. What follows is a brief history of this latest, all-American contribution to miniature radial-engine technology.

The production Robart, 7-cylinder, 4-stroke radial briefly roared to life at the Toledo Show, and instantly drew a crowd of interested modelers. Its even-tempered growl at idle and the impressive, cyclone-like propwash from its 26x16 prop during a fleeting burst of full power, clearly distinguished it from its single- and twin-cylinder brethren.

DESIGN HISTORY

In the late '70s, Bob Walker, owner of Robart, decided he wanted to manufacture a radial engine that would have enough horsepower to easily power the then-new breed of giant-size models. Would it make sense to use off-the-shelf parts as components? He first designed an engine that used existing 4-stroke heads and cylinders from other manufacturers. After several attempts, he decided that the best production engine would have to be entirely custom-designed.

Bob read and studied everything he could find about radial engines and collected a fairly large library of books and data on aircraft engines. He also purchased a worn-out, full-size, 225hp, 7-cylinder Jacobs radial engine to take apart and study. From the design and layout of the full-size engine, Bob got his inspiration. From the start, he wanted to produce a quality engine that would stand the test of time and run reliably. Robart intended to produce more than just a "collector's item."

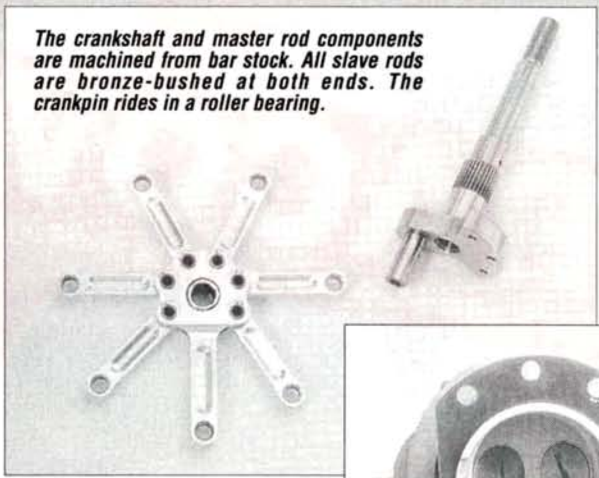
It had to look like a Jacobs, have as much displacement as possible and still fit in a 10-inch-diameter engine cowl, have a good service life and be easy to manufacture and market at a reasonable price. The production engine that debuted at Toledo appeared to meet these design parameters.

THE PROTOTYPE

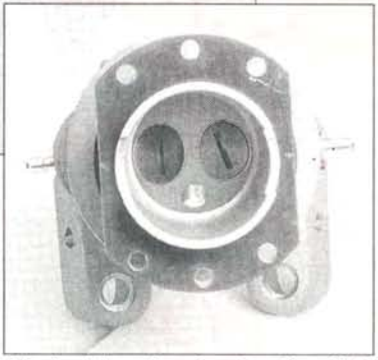
Design work on the first engine started in 1985. The engine was conceived so that its manufacturer could take full advantage of CNC (computer numerical control) manufacturing techniques.

Bob wanted a hemispherical head design with large valves, and he made a pattern of the head so it could be made in a casting. Except for these castings, the entire prototype engine was made of bar stock. After two years of work, the prototype was finished, and it ran well. Robart exhibited the proof-of-concept at various trade shows, where it was received with wide interest.

Having made the decision to go into production, Bob dove into the Auto CAD (computer-assisted design) drafting program. Auto CAD was used to redraw all the parts of the engine (as well as almost every other part now manufactured by Robart). Bob remarks that learning the system took almost a year. (Chuck Sostak, a full-time drafting engineer at Robart, offered key help.) With the final production engine drawings finished, Robart was ready to start building engines.



The crankshaft and master rod components are machined from bar stock. All slave rods are bronze-bushed at both ends. The crankpin rides in a roller bearing.



The head is an investment casting. Note the oversized intake and exhaust valves and the hemisphere-shaped combustion heads. Valves and valve-seats are made of hardened steel.

The cylinder is machined from bar stock, and the liner is chrome-plated. Nipple fittings and bridge tubing supply lubrication to rocker boxes.

100 PERCENT AMERICAN-MADE

The production engine uses six different precision, "lost wax" investment castings. Basic components are made of aircraft-grade aluminum alloys and steel. The use of castings allowed Bob to meet his goal of producing a 7.8cid engine that weighed only 7.2 pounds.

Since Robart does not yet have CNC machining capabilities in-house, several American-based subcontractors handle the casting, stamping, gear cutting, machining, tubing bending, plating, anodizing and welding required to produce such a complicated engine. Paul Knapp, of Napco LTD in Tempe, AZ, does the machining of the head and the front and back housings. Bob Obenberger, of Tru Turn Spinner fame in Houston, TX, does the machining of the crank case, rods and cylinders. Art Swanson, of AMS in St. Charles, IL, made the cams, and the rest of the parts are made at Robart. Bob takes great pride in saying that the Robart radial engine is 100-percent American-made.

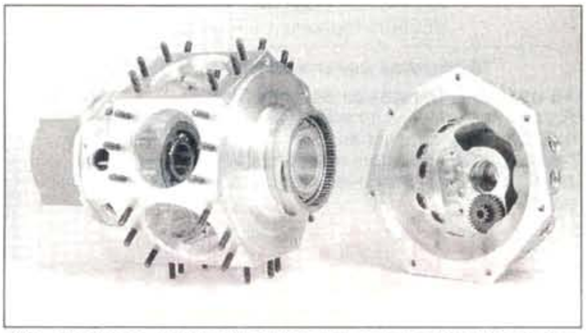
The engine has chrome-plated aluminum cylinders, aluminum pistons (with two cast-iron compression rings each) and machined-aluminum conrods. The valves and valve-seats are made of hardened steel, as are the cam and roller lifters. The valve guides are made of hard bronze. Except for the master rod, which has roller bearings at the crankshaft, there are bronze bushings at each end of the connecting rods. The rocker arms are made of hardened stainless steel.

PERFORMANCE

With all those parts working in unison, the radial produces an estimated 10 to 12hp and has a maximum 6,500rpm turning a 26x16 prop while burning a standard 4-stroke fuel blend with 5 percent nitro. The prop is held on the $^{7}/_{16}$-inch-diameter output shaft with six 10-32 prop bolts around the outside of the hub and a $^{3}/_{8}$-24 nut at the center. The engine has a single updraft carb with a venturi diameter of 0.370 inch. The short exhaust stacks are arranged just like the full-size Jacobs radial. An exhaust collector ring is available as an accessory.

Two versions of the engine are available: glow and spark-ignition. The glow version at the show used a McDaniel* 7-cylinder glow-driver system to light all the cylinders. The spark-ignition version will have a capacitor discharge system with

(Continued on page 94)



PHOTOS BY WALTER SIDAS & TOM ATWOOD

The crankcase and the front housing are machined from bar-stock aluminum. Note the intake impeller housing (far left) mounted on the rear of the crankcase. This impeller charges the combustion chambers with fuel.

SPECIFICATIONS:

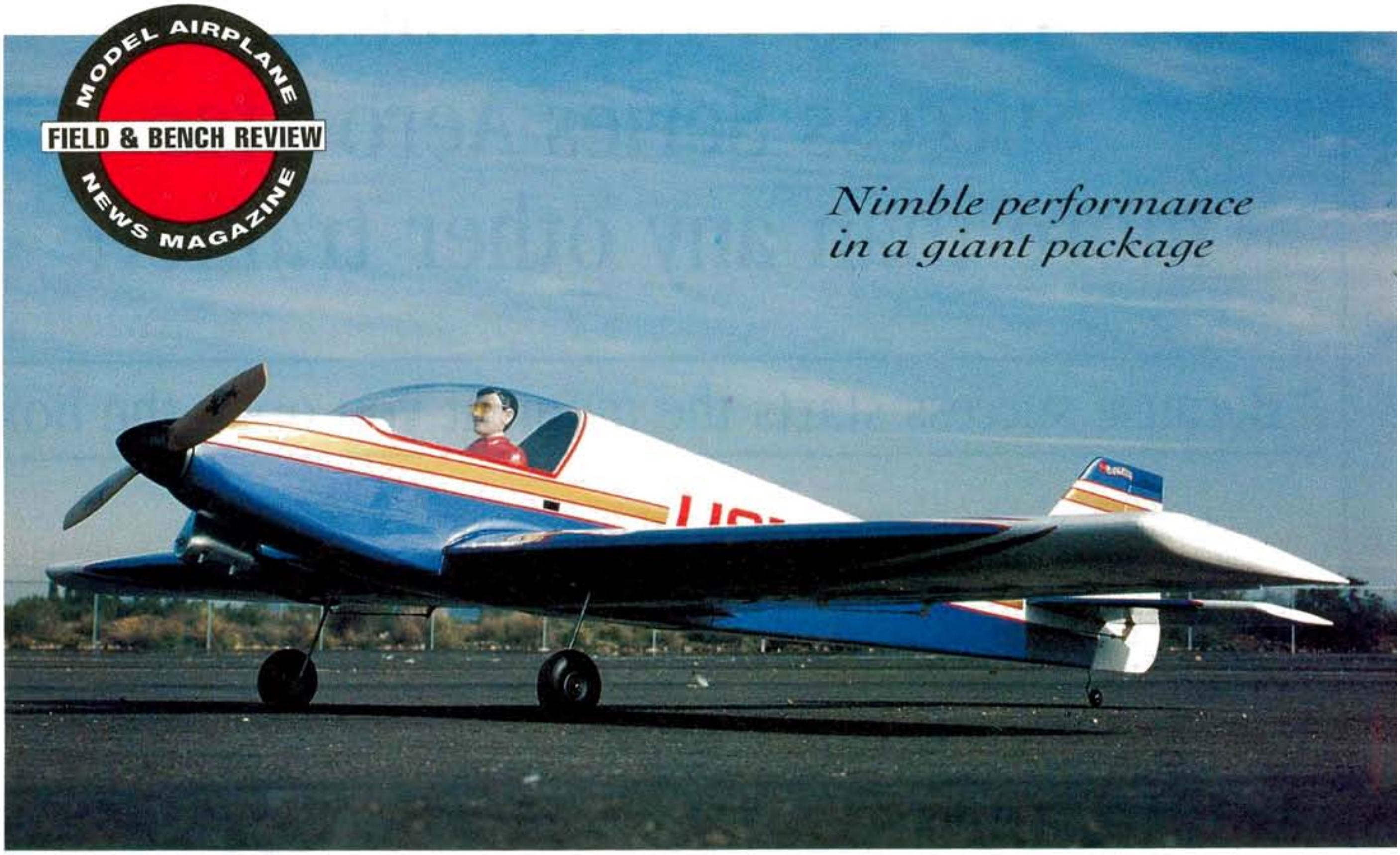
Robart 7-cylinder 4-stroke radial glow engine

Weight and dimensions:
Capacity: 7.8 cu. in. (128cc)
Bore: 1.125
Stroke: 1.125
Stroke/bore ratio: 1:1
Induction system: single updraft carburetor
Carburetor venturi diameter: 0.370 in.
Output shaft diameter and thread: $^{7}/_{16}$ in.; $^{3}/_{8}$-24 (six 10-32 prop bolts)
Engine diameter: $9^{13}/_{16}$ in.
Engine length: $7^{3}/_{8}$ in. (from firewall to back of prop)
Overall weight: $7^{1}/_{2}$ lb.

Performance:
Max. horsepower: 10 to 12hp (approx.)
Max. rpm: 6,500
Idle rpm: 1,600 to 1,800
Prop used: 26x16
Plugs used: Sonic Tronics* (with McDaniels 7-cylinder glow-driver system)
Fuel: 5-percent nitro 4-stroke blend

Prices:
Glow: $3,500
Spark ignition: $4,000

Comments: ignition systems are available from Robart for the glow and spark-ignition version. Prices do not include the ignition systems. The welded, steel-tube engine mount comes with the engine and is made of $^{1}/_{4}$-inch-diameter steel tubes. It also includes Lord-type rubber mounts to absorb vibration.



PHOTOS BY MIKE LEE

ULTRA SPORT 1000

by MIKE LEE

ONE OF THE designs destined for success in branching out to other sizes is the Great Planes* "Sport" aircraft series. The original aircraft—the Super Sport 40—appeared to be a distant relative of the RCM Sportster. But the similarity ended with appearance: the Super Sport went on to become one of the most beloved low-wing sport aircraft of our time. It possessed good handling over a wide flight envelope, was built tough enough to withstand weekend abuse and could be quickly assembled. These characteristics were later seen in the Ultra-Sport 60 version—a slightly souped-up and snazzier model for those who wanted something bigger and more powerful. The entire "family" was well received.

The trouble with creating a family of aircraft is that merely blowing up or shrinking the original design doesn't accomplish all that's needed. The airframe must be changed to handle different flight loads. Tail moments, nose design, wing strength, airfoils and even construction materials aren't universally interchangeable. So, making a successful family of aircraft is just not that easy. Great Planes, however, seems to have a knack for doing just that, and this brings us to the subject of our review: the Ultra-Sport 1000.

The US1000 is a giant version of the Ultra-Sport series of birds and has the same terrific look of the others. It's meant for the big bird fan who desires a sporting aircraft, and it's capable of hot-dogging in the sky. With slight wing modifications, it can be legal for IMAA events.

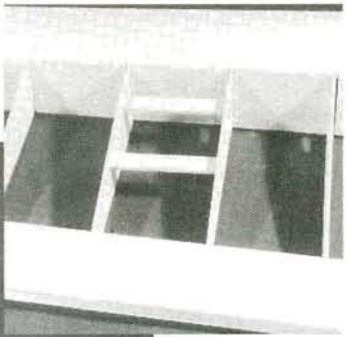
The US1000 has an 80-inch wingspan, and it carries almost 1,100 square inches of wing area. It's 65 inches long, and it's designed to handle .90 to 1.50 2-cycle engines, or 1.20- to 1.60-size 4-bangers. Construction is of conventional balsa, ply and spruce.

CONSTRUCTION

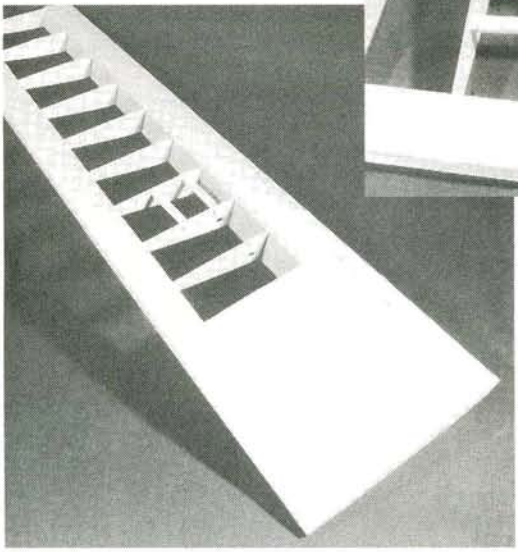
The instructions for the US1000 are among the best around. The well-illustrated, 60-page manual includes tips for builders, conversion tables for metric and English sizes and even line drawings of the aircraft to help you decide which color scheme to use. The two sheets of full-size blueprints cover all areas of the construction. The US1000 requires no more building skill than the average modeler has. If you can read, you can build it.

TAIL-FEATHER ASSEMBLY

First, assemble the tail feathers of the Ultra-Sport. These are built-up surfaces that use geometric cross-bracing sandwiched between two pieces of 1/16-inch balsa sheeting. The completed parts are very rigid, yet lightweight. By the way, don't throw away your "scraps." Scrap parts can be used in other places on the Ultra-Sport.



The ribs are designed to have separate aileron servos in each wing panel. The forward mount rail is in a slot and can slide into position to accommodate a servo of any size.



This is the completed wing half. Other than the size, there's really no difference between this wing and a typical sport airplane's wing. The wing uses a strong "D"-tube type construction.

During tail-feather assembly, you'll have to cut out most of the parts. But, there are some machined parts used here.

One of the decisions you'll have to make while you assemble the tail feathers is whether you want conventional landing gear, or a tail-dragger. There's a lot of room in the wing for retracts, so even the first-time retract builders shouldn't have any problems. (I opted for the tail-dragger version without retracts.) You must decide at this point so that you can prepare the rudder for the tail wheel.

WINGS

The modified "D"-tube wing uses a multi-layered balsa spar on the top and the bottom. It's further strengthened with shear webs on the spar, and these extend to the wingtip. The wing's center section is fully sheeted and held together with a plywood dihedral brace. If you think this sounds like something you've handled before, you're right. It's

The US1000 is a giant version of the Ultra-Sport series of birds and has the same terrific look of the others. It's meant for the big bird fan who desires a sporting aircraft, and it's capable of hot-dogging in the sky. With slight wing modifications, it can be legal for IMAA events.

SPECIFICATIONS

Model name: Ultra-Sport 1000
Manufacturer: Great Planes Model Distributors
Type: Sport/pattern (giant)
Sug. retail price: $199.95
Wingspan: 80 in.
Wing area: 1,060 sq. in.
Wing loading: 26.08 oz./sq. ft.
Weight: 12 lbs.
Length: 65 in.
No. of channels req'd: 4 (elevator, aileron, rudder, throttle)

Power req'd: .90 to 1.50 2-stroke; 1.20 to 1.60 4-stroke
Engine used: SuperTigre 2500 2-stroke
Airfoil type: Fully symmetrical, "D"-tube wing
Wing construction: Built-up balsa and ply
Kit construction: Built-up balsa, ply and spruce
Washout: None

Features: extensive hardware outfit, wide variety of landing-gear configurations, excellent plans and instructions, and parts fit well.

Hits:
- Easy to assemble
- Well-thought-out instructions
- Very good flight characteristics

Misses:
- None reported

FLIGHT PERFORMANCE

- **Takeoff and landing**
The Ultra-Sport 1000 with a tail-dragger configuration is a "no-brainer" model. You'll need just a slight kick of right rudder when the throttle comes up, and then you can relax. The tail comes up quickly, and you can ease the plane up within a few seconds. Then, the US1000 goes wherever you point it, and it doesn't fall off during throttle changes.

On the landing approach, the US1000 uses a lot of air, so be prepared for a lengthy glide. It's no more difficult to handle than the average sport-40-size bird, and it has no bad habits as it slows up. Stay on the elevator when the wheels touch, since the plane can lift off again if it's given any air speed. It's pretty docile when it comes in; and I don't think you'll ever wear out the tires on this one!

- **High-speed performance**
At wide-open throttle, the Ultra-Sport is very solid and it has no surprises. It goes wherever you want it to, without complaint. Top speed flight approaches that of a hot 60-size bird, but, owing to the ship's size, it seems slower. You can definitely see this bird in the sky.

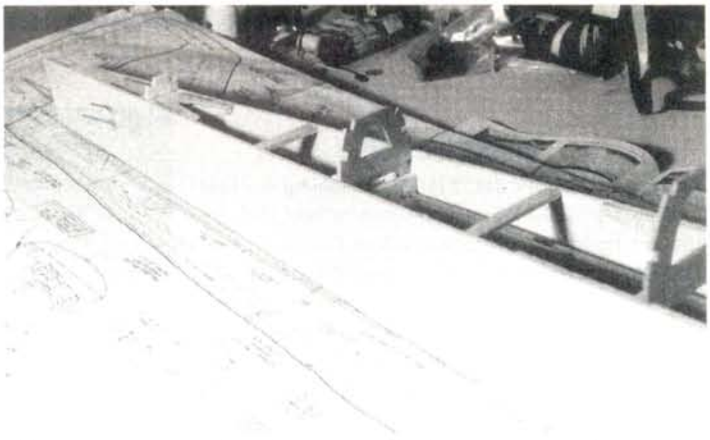
- **Low-speed performance**
Throttled back, the US1000 won't drop a wingtip, nor will it get tipsy, even during the landing flare. It does a nice stall that is slow and predictable. It does float a long distance when making the landing approach, so it will pay to watch the glide path carefully.

- **Aerobatics**
This is where the US1000 comes into its own. Loops are big and effortless. The plane rolls cleanly; it performs a roll every second with the kit-recommended aileron throws. Point rolls are pretty good, but there is a slight rolling tendency with the application of right rudder. Stall turns are nicely done. Inverted flight requires a noticeable touch of down-elevator, but nothing excessive for this size aircraft. The plane enters spins fairly slowly, and then it falls into a controllable spin rate. It will stop the spin within ¼ spin after the controls are released. For many pilots, the US1000 will provide the feel of handling a "Tournament of Champions" aircraft.

no more difficult to build than other sport aircraft you might have already built.

Assembling the wing is fairly easy, but it requires a lot of room. This wing is big, so clear off your entire workbench.

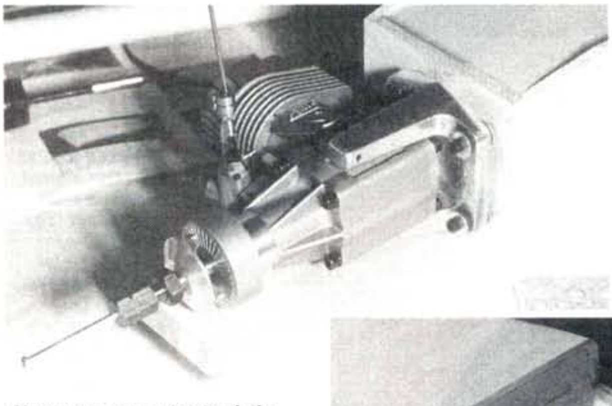
You'll also find that the wing accommodates separate aileron servos. Don't even think about using one servo for both ailerons; if you do, you're asking for trouble! The US1000 uses strip ailerons, and if you use a couple of standard-size servos, you're way ahead of the game. The ribs are also cut to allow servo-wire extensions to reach the servos. The included servo rails can be mounted and adjusted to fit practically any servo.

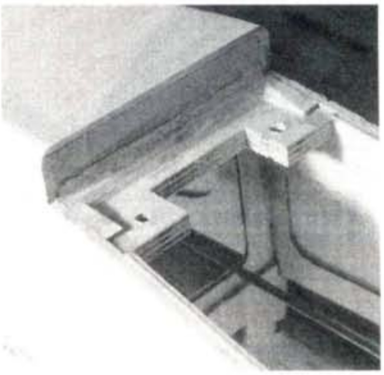


This is the rear portion of the fuselage, which shows the placement of the formers and the turtle deck upper formers. For modelers with a kit or two under their belts, there's nothing to worry about.

Once the wing sections have been finished and the wing has been joined to the wing brace, sand the center section and then reinforce it with fiberglass cloth. This is one of the few places that I used epoxy (a few ounces of Hobbypoxy* II 45-minute epoxy). Although the instructions describe a good method of applying the fiberglass cloth, I used a different one that entails tacking the cloth with CA. Simply place the cloth next to the trailing edge, and apply a bead of Satellite City's* Hot Stuff Super T adhesive to the balsa. Lay the cloth over the adhesive and allow it to set. Next, pull the cloth taut around the leading edge to remove any wrinkles. As you pull, apply another bead of Hot Stuff to the cloth at the leading edge; this will soak through and hold the cloth. Flip the wing over and pull the cloth to the rear, smooth it out and affix it with one final bead of Hot Stuff. Cut off the excess cloth. Pour epoxy over the wing, and work it into the cloth and onto the balsa. Allow it to set, and you're done.

To finish the wing details, add the wingtips, aileron stock and trailing edges. Sand the assembly, and set it aside.





Above: to prepare to attach the nose-cowl parts, mount the ST 2500 engine to the firewall. Notice the use of J'Tec's Snuff-Vibe engine mount. This isolated rubber mount works very well to reduce noise and vibration.

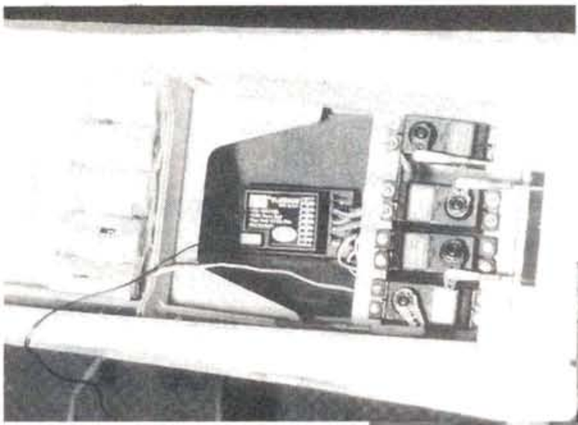
Right: the wing-mounting plate is made of reinforced plywood. Triangle wood stock on both sides helps to distribute the load and provides a great deal of strength.

FUSELAGE

The fuselage is made of plywood-reinforced balsa. Again, keep your workbench clear, because this baby is long. Despite the plywood reinforcement, the fuselage is light.

By this time, you should have decided which engine to install in the US1000 because the firewall placement depends on your choice. It can handle a powerplant right on up to—and including—the SuperTigre 2500. (This is the upper limit of the manufacturer's recommendations.) The designers have tested a wide variety of engines to determine the effects of each. Based on their results, they provide the firewall positions as well as the engine thrust settings for a large number of engines. This is the first time I've seen this done, and I hope that other manufacturers will follow this example.

Despite the space it occupies, the fuselage goes together like any other normal-size sport bird. Except for the firewall area—which was



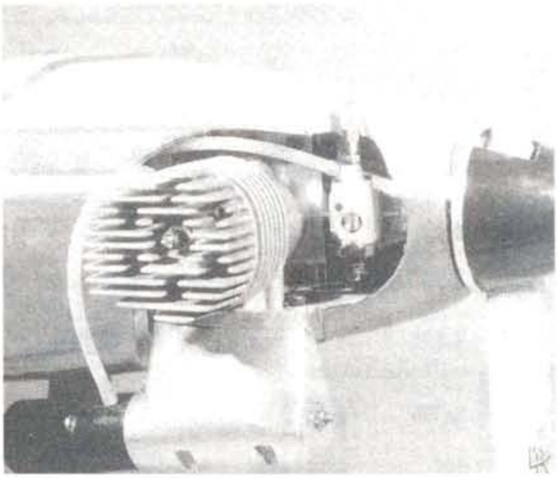
Left: the radio gear is in place and there's still lots of room for more. Notice the 5-cell, 1700mAh battery pack.

Below: the use of die-cut plywood parts with interlocking-tab construction greatly simplifies fuselage building.

epoxied—the entire assembly was glued with Satellite City's Hot Stuff Super T. If you use a nose-gear setup, or if you want additional security, the instructions tell you how to use toothpicks to "pin" the firewall in place. Many big bird builders usually do this, and it would also work well on this plane. I pinned mine, but only for the sake of practice. (Oh, all right, I wanted to be safe!)

Install the pushrods just before you add the top sheeting. The kit provides steel rods that run in plastic outer sleeves. The sleeves are supported by plastic spacers, which help prevent flexing. The whole thing works very well.

Next, mate the fuselage to the wing. The rear of the wing is held with 1/4-20 nylon bolts, and wooden dowels are used on the front. Add the completed nose blocks to the otherwise-flat firewall, and—once the engine is mounted—carve them to the final contour of the nose.



I use a J'Tec Snuffler muffler for the SuperTigre 2500. It works very well.

Next, I worked on the turtle deck. It's made of three lite-ply formers on the top of the fuselage with balsa stringers and balsa side sheeting. After I had completed it with a thick balsa plank, I began carving to shape. There's plenty of balsa to remove, so don't be shy. You need to achieve that rounded, turtle-deck look that distinguishes this bird from others. From here, you can move on to the cockpit area, the nose blocks, the spinner ring and the final assembly.

Final assembly includes mounting the tail feathers and fairing them in. This is the first aircraft that I've seen whose horizontal stab is not only glued into place, but bolted as well. Between the glue and the bolt, nothing short of the front door closing on the tail will remove the stab.

FINISHING

Complete the covering with Top Flite's* Super MonoKote. You'll need about double the amount that would be needed for a typical sport aircraft, so be prepared. I sealed the firewall area with epoxy to fuelproof it, and then I dropped the radio equipment in. The amount of space is terrific, and there's lots of room for a big 1700mAh battery. A guy could really get to like this!

RADIO

I used the Ace* MicroPro 8000 system with an RCD* Platinum Grade AM receiver and Futaba* FPS-148 servos. This allowed me to electronically couple twin servos for the elevator and for the ailerons—without a Y-harness. If you have access to a programmable radio, electronic coupling provides redundancy and, therefore, added security.

(Continued on page 104)

GOLDEN AGE OF R/C

HAL DeBOLT

R/C'S WILD WEST ROOTS

THIS WILL BE a nostalgic trip for those who were in on the start of R/C on the West Coast. I wish I had photos to accompany it, but as you'll understand, what I saw isn't reproducible here. However, the history is great, and the names should ring a bell for many West Coasters and for those who attended early R/C Nats.

How many of you remember Darryl Usher of Cornelius, OR, who had a hand in early pylon racing, plus *anything* R/C at the time? Perhaps you recall the full-scale Midjet Mustang with a retractable landing gear that he built and flew. Darryl is still active, and he does some fine flying with an F-86 fan jet. What makes our report possible is an innovative project of his that we viewed along with OTers Harvey Thomasian and Tom McCoy.

VIDEO HISTORY

I'm not versed in video production, but Darryl indicates that what he has done is a simple procedure. He took 8mm movie film from the early days and copied it onto videotape. Darryl suggests that this would be a great way to preserve that history. Wonder how he did it? Send him a note (his address is at the end of this column).

An early West Coast Mustang Club session brought a good turnout in the Frisco Bay area. Note the variety of designs and the tripod-mounted transmitter.

Darryl's tape is a montage of flying sessions at various West Coast locations, and he has added a vocal commentary. It's a good rendition of what early R/C was like on the West Coast. The best I can do is describe what was flown and note some of the prominent R/Cers shown.

Bob Dunham helps Dick Evett prepare his Stormer for an official flight.

Apparently, the Dollar family (of Steamship fame) allowed R/C flying on their ranch. In the episode there, Dale Root is flying his Low Ender with reeds, of course. Of particular interest is how reliable his concocted retractable gears appear. Could this have been the seed that sprouted into what we have today?

Speaking of retracts, at another session, we see Ray Down's Astro Hog with a Rube Goldberg mechanism that tucked the wheels away. These two efforts provided the inspiration that led to the first commercial retract gears by Dmeco.

At this session, we also see the rudiments of today's Formula 1 pylon racing. Remember that in those very early days, Jerry Nelson conceived what is now Formula 1. The video shows Jerry test-flying his version of the Rivets, which later became a perennial Nats winner in the hands of Joe Foster. We also see R/C pioneer Dick Riggs flying his Midjet Mustang racer. Throughout the sessions, many people fly racers; the beginning of pylon racing is apparent.

Otherwise, the general flying is dominated by the popular cabin-style designs. Various versions of the Smog Hog are prominent. Orbit radios filled the scene with an occasional Min-X. Ed Van Allen is seen doing his thing. Much later, Ed would astound the established Formula 1 fraternity by winning the prestigious International race at age 65! Who says age is a handicap?

Another session is at Bakersfield–an early mecca for R/C. Walt Good attended this affair, and he was obviously pleased to see a lot of Rudder Bugs doing their thing. All flying was done "one at a time"; 27.255MHz was the only frequency available! (We should all thank the AMA!) A 9-foot Berkley Custom Privateer cruised majestically with rudder only. Also, Bill Deans (of connector fame) is seen flying a single-channel Sterling Tri-Pacer in a most realistic manner.

Howard Bonner has a smile of success as he watches his Smog Hog perform at an early West Coast meet.

NORTHRUP'S HIGH CLIMB

We set the stage for world records a few issues ago by telling how Maynard Hill got involved and how the Washington D.C. R/C club helped at the Naval Weapons Lab in Dahlgren, VA. The first record trial was held in July 1963. Maynard established an R/C altitude record, and Bob Scott set an R/C speed record. Another trial was scheduled for Labor Day weekend, 1965, and at this one, the major goal was to better Maynard's record of 13,320 feet and the Russian world record of 13,700 feet (done with a free-flight). After Maynard and Joe Solko had both failed with their attempts, it was up to Bill Northrup to carry the banner.

Bill felt that a special design would be required to accomplish the task; the model would have to be large enough to be visible and to carry the necessary load of fuel. A low total weight and a good power loading would be necessary to provide the 500-foot-per-minute rate of climb that was determined to be the minimum. Thus, design was important. Bill's model was the 8-foot-span Foo Too, which was powered by an ST .56 and carried 16 ounces of fuel. He used a Quadraplex radio by Don Brown. The name Foo Too, was part of a catch phrase aimed at the Air Force's high-flying spy plane: "Foo too you U-2"!

Maynard Hill consults with a Navy officer before his unsuccessful attempt at the Naval Weapons Lab at Dahlgren, VA. Note the radar disk antenna and the projectile tracker with 6-foot-long, 33-power binoculars on top and 20-power, wide-angle lenses on bottom.

Bill's record attempt began with some worries. The engine had been in a previous mishap, and there hadn't been time to evaluate it. Because of interference, the radio frequency had to be changed at the site using rudimentary tuning equipment. There was a lot of hope and prayer with this attempt!

Bill flew the Foo Too using 6-foot-long, 33-power binoculars mounted on a projectile tracker. Walt Good operated the tracker, keeping Bill's binoculars aimed at the model by following it with 20-power wide-angle lenses and maintaining radar contact.

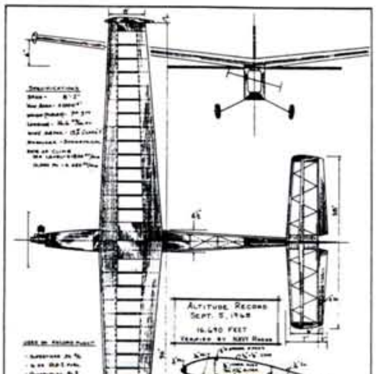
On takeoff, Bill had a twinge of apprehension. The engine sagged lean, but he quickly realized that this could be for the better, since the mixture would richen with altitude. The flight progressed uneventfully. One-minute radar reports indicated a rate of climb that was greater than anticipated. At about 10,000 feet, the model stalled and started to lose altitude. In his anxiety, Bill had increased the angle of climb too much. Once the correction had been made, 20 minutes into the flight, the Foo Too beat Maynard's record, and the Russian record was topped a minute or so later.

A young Bill Northrup with his record-setting Foo Too and the Quadraplex radio he used.

Success! With all going well, the flight was continued until the Foo Too reached its maximum altitude of 16,610 feet. Walt reported difficulty keeping the model in sight with his 20-power binoculars. It was decided that discretion was the better part of valor, so he started his descent to ensure the required landing within 500 meters of takeoff.

Unfortunately, at about 14,000 feet, the tracker shut down with the model still out of sight. What to do? Luckily, they still had radar, and with that guidance—plus many eyes glued to the sky—the Foo Too was flown into sight and the rest of the descent was academic. With a landing well within the required limits, a happy and jubilant Northrup collapsed on the runway from sheer exhaustion!

What an ending to a record trial that was plagued by so many unfortunate circumstances! In only 25 minutes, two world records had been eclipsed, and Bill Northrup was sure of his place in history!



Three-view of the Foo Too with details of the special design used for record attempts.

(Continued on page 74)

GOLDEN AGE OF R/C

The Sterling Tri-Pacer as flown with rudder-only by Bill Deans. This scale model was one of the very few that rivaled the specialized R/C rudder-only designs in performance.

The video also has some scenes from one of the first major West Coast contests held at a small airport near Turlock, CA. This meet apparently attracted the elite of West Coast R/C at the time. Bob Heise does a respectable flying job with what must have been an embryonic proportional system.

Meets in those days included three classes: multi-channel, single-channel and pylon. Pylon was very new so you raced whatever you had; however, the Nelson-inspired racers seemed to dominate the event, even though Chuck Boyer won with his P-51-inspired pattern bird.

Single-channel was well-attended by the usual crop of cabin styles, mostly Smog Hog look-alikes. One flier did some exceptional flying with a rudder-only scale Cessna 180; you just didn't try to fly scale with rudder only!

We should be aware that R/C didn't spring up all at once across the USA. Instead, the initial growth occurred on the East and West Coasts, and the rest of the country followed. Darryl gives a description of how simply it began before it exploded on the West Coast.

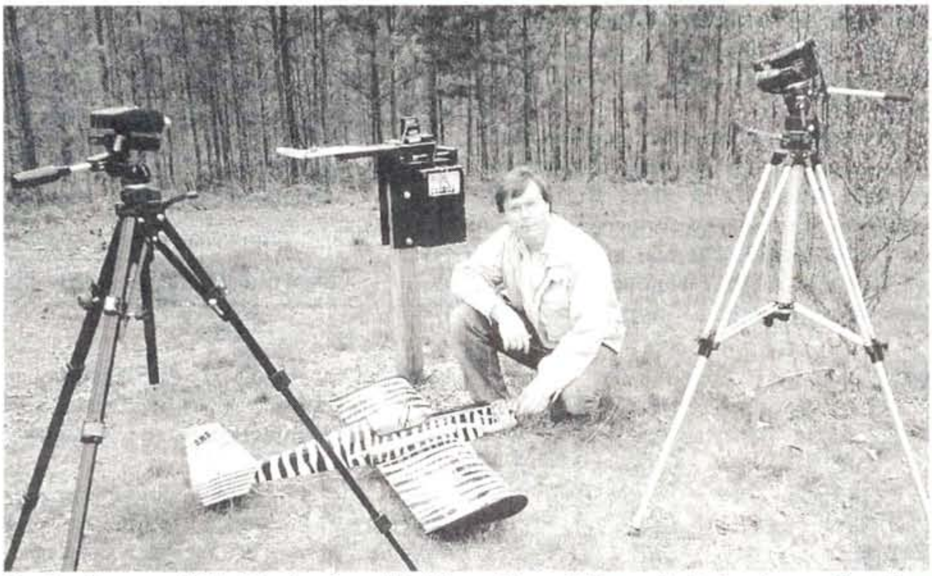
Darryl Usher, 9810 NW Gordon Rd., Cornelius, OR 97113. ■

Reducing Engine Noise

PART 1

Practical solutions that can help save flying fields

by DENNY ATKINS & RAY ABADIE



Ray Abadie poses with field-test equipment that he and Denny Atkins used to test various configurations of mufflers and props. Note the test stand (middle), the dB meter (left) and the video camera (right).

Editor's note: this two-part series examines the noise problems posed by glow-powered models and explores sound reduction techniques that use various combinations of readily available, off-the-shelf components. The intent is to share information that will improve personal safety and field preservation. However, the solutions presented entail operation of model engines in a non-traditional way. The propeller recommendations effectively trade horizontal flight speed for significant reductions in sound levels, enhanced vertical performance, improved acceleration from low speeds and shorter takeoff runs.

This series does not purport to offer a final, one-size-fits-all cure for model engine noise. For example, the compromises proposed are not practical for high-rpm applications involving ducted fans or pylon racers. Nonetheless, the authors have drawn conclusions that we believe you will find of interest. Do you agree with the theories applied and approaches recommended? Do you have additional suggestions? Write and let us know. Selected letters will be published in "Airwaves."

Huh? What's that you say? Would you mind repeating that? I couldn't understand what you said. Would you turn up the TV? I can't seem to understand what they are saying.

If you or someone you know uses these expressions a lot, chances are that person's hearing has been damaged by sound. That's right, your hearing can be damaged by sound, either too loud or for too long.

For years, the modeling community has focused on sound from a field preservation standpoint; yet, a concern of equal or greater importance has been all but neglected. As modelers, our hearing is subjected to sound in unsafe and harmful ways! In order to protect your hearing, you must know a little about sound, namely, what it is, how it is measured and how it affects you.

WHAT IS SOUND?

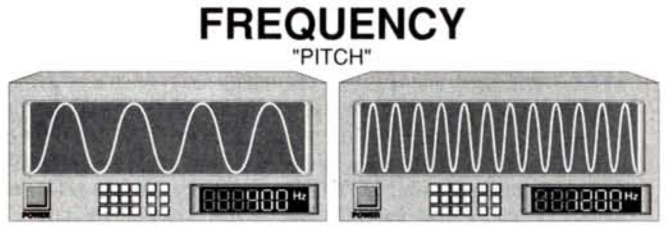
Sound is a vibration that travels through a medium, usually air. There is no sound in a vacuum. Unwanted sound is called "noise." This is a very important fact. It is not only loudness that determines when a sound becomes noise, but rather the subjective opinion of whether it occurs when it is not wanted!

Too little has been said about good neighbor relations as a way to preserve flying fields. We believe that happy neighbors who are consulted and invited to become involved are less likely to take a stand that the sound coming from our fields is "noise."

Yet, there are levels at which sound is not only annoying, but indeed harmful. In our lifetime, sound has increased to such levels in urban areas that it has become "the great invisible pollutant" and the cause of a growing problem—hearing loss (see sidebar).

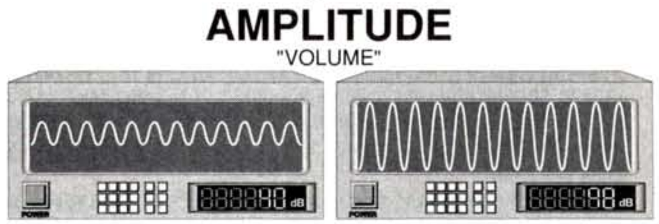
How do we measure it? Two primary characteristics define a sound: its frequency and its amplitude. Frequency is measured in oscillations per second in units called "hertz" (Hz). We call this the "pitch" of the sound. A foghorn has a low pitch, whereas a siren has a high pitch (see figure 1).

The amplitude of a sound wave determines its pressure. We refer to this as the "volume" of the sound, and we measure it in decibels (dB) (see figure 2). In this article we will use the terms "volume" and "sound pressure" interchangeably.



The frequency is the number of oscillations per unit of time. It's measured in oscillations per second in units called hertz (Hz). The scope on the left shows a lower frequency signal.

Figure 1



This is the "strength" of the oscillation. For sound, it is measured using the decibel (dB) scale. The scope on the left shows a lower amplitude signal.

Figure 2

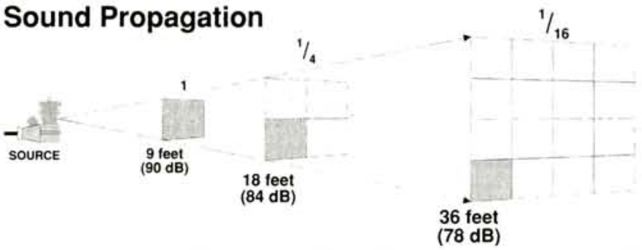
SOUND FACTS

The dB system is based on a logarithmic scale. No need to panic; this article is not meant to be a math refresher course. Simply remember that it is not linear. This means that 100dB is not twice as loud as 50dB. Instead, sound pressure doubles every 3dB. For example, 96dB is twice the volume of 93dB.

In its incredible adaptability, the human ear can perceive sounds starting at 0dB (the threshold of hearing) up to levels at which it is instantly damaged (more than 120dB). The price we pay for this range is a relative insensitivity to smaller changes in sound pressure and, indeed, the human ear perceives a doubling in volume about every 10dB. For example, our ears would sense twice the volume when going from 93dB to 103dB, though the actual sound pressure would have increased over eight times!

Sound pressure decreases by the square of the distance. In other words, at twice the distance, sound pressure will be one-fourth as great (figure 3). You can think of this as the same amount of sound energy being spread over more area as we move away from the source. Since a 3dB drop is half the sound pressure, one-fourth the sound is a decrease of 6dB (2 x 3dB = 6dB). In simple terms, each time you double the distance, the sound level drops 6dB.

The human ear perceives sounds whose frequencies are in the range of 1,000 to 5,000Hz better than all others. Higher frequencies in this range are generally perceived as louder. The reason for this is twofold. First, a higher frequency means that more oscillations (sound waves) strike your eardrums per second. Second, the sensors in your inner ear that detect high frequencies are ahead of those that detect lower frequencies (see sidebar).



Every time you double the distance from the source, sound diminishes by 6dB.

Figure 3

dB LEVELS OF COMMON SOUNDS

Threshold of hearing	0 dB
Quiet whisper	18 dB
Average residence (0 kids!)	44 dB
Telephone dial tone at 1 inch	53 dB
Typical conversation	62 dB
Digital alarm clock at 1 foot	82 dB
AMA proposed limit at 9 feet	90 dB
Jet 2,500 feet overhead	93 dB
Thunder at 1,000 feet	108 dB
Threshold of pain	120 dB
Instant hearing damage	120+ dB

Figure 4

The effects of harmful sound levels are cumulative. Prolonged exposure to lower volumes can be as detrimental as short exposure to higher volumes.

O.S.H.A., the government agency that polices safety in the workplace, has guidelines dealing with sound. They say your

HEARING LOSS

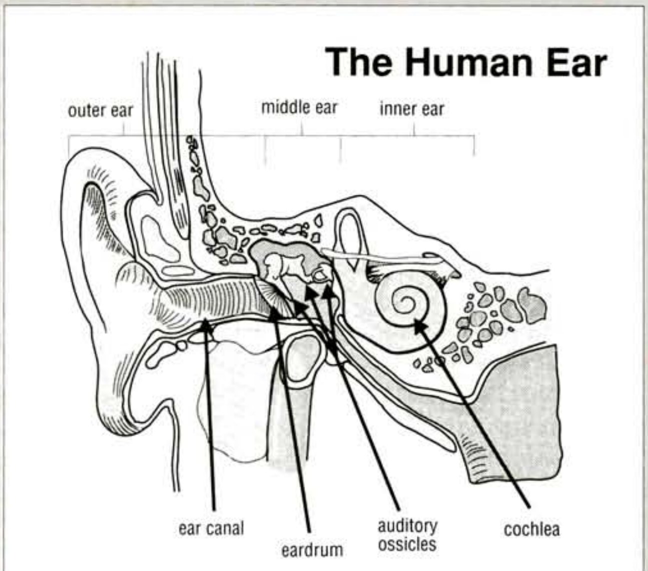
There are more than 35 million people in the U.S. with seriously impaired hearing, and hearing loss is increasing. The U.S. public health service says impaired hearing is the nation's leading handicapping condition; it affects more people than any other condition.

The most common form of hearing loss is the loss of high-frequency hearing. The most common cause of high-frequency- hearing loss is noise. There are three main sections of the ear—outer, middle and inner. The outer ear funnels sound into the ear canal where it can reach the eardrum. The middle ear, which contains the auditory ossicles (also known as the hammer, anvil and stirrup), receives sound through the drum and transfers it to the inner ear (cochlea). The cochlea looks much like a snail shell. It is filled with fluid and contains about 25,000 tiny hair cells that are selectively tuned to pitch frequencies within the normal range of hearing.

Sound causes the fluid to act on these hair cells, which, in turn, generate a tiny electrical current that sends the sound through acoustic nerve connections to the brain. The hair cells that are tuned for high-frequency sounds are located at the beginning of the cochlea, and those tuned for lower frequencies are located at the apex.

When exposed to a high level of noise, the fluid in the cochlea is moved so violently that it damages some of the hair cells. A sudden, very loud noise will destroy a lot of the hair cells at once, or a lower level noise for a long period of time will destroy a few hair cells at a time.

In either case, once the hair cells have been damaged, they never recover. This is why the effects of noise are cumulative. Since the hair cells that are tuned for high frequencies are at the beginning of the cochlea, they are usually the most severely affected. This explains why high-frequency-hearing loss is the most common type.



In speech, vowels are received as low-frequency sound and consonants as high-frequency sound. A person with high-frequency hearing loss will hear fragmented speech. Take the proper precautions when running your model engines to avoid this problem!

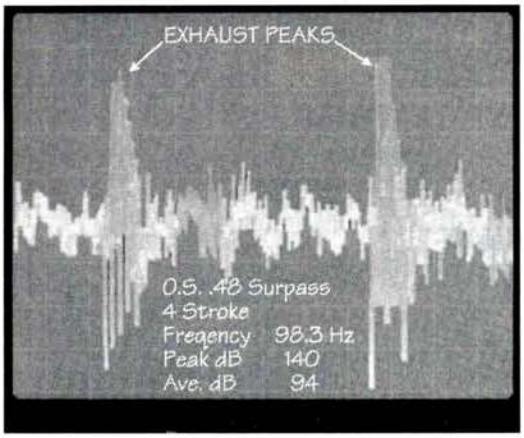


Figure 5

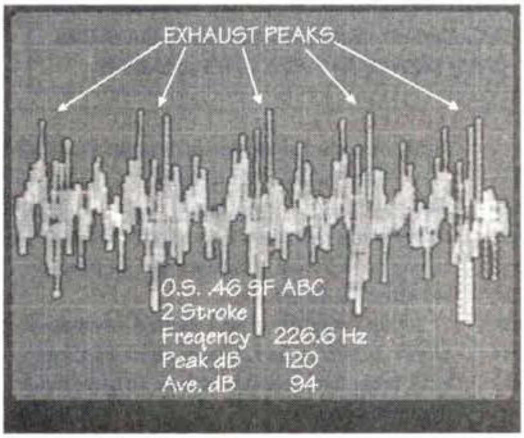


Figure 6

unprotected ears can take 30 minutes at 110dB, 2 hours at 100dB and 4 hours at 95dB. The table in figure 4 shows the levels of common sounds.

SOUND AND MODELS

The most significant sources of sound in model aircraft are: complaining neighbors and spouses, engine exhaust, propeller noise, airframe vibration and induction noise. If we can successfully deal with the last four sources, the first one will take care of itself!

In a situation where there are several sources of sound, the loudest will generally mask the volume and frequency of the others. This makes it important that the sources be identified and dealt with individually, starting with the loudest.

Of the sound sources we have identified, the most important is engine exhaust.

THE 4-STROKE MYTH

A common misconception is that 4-stroke engines are quieter than 2-strokes. The image in figure 5 is the sound of an O.S. .46 2-stroke engine running at 13,600rpm. The number of peaks indicates the number of times the engine fired in the period of time it took the scope to trace from left to right. The height of these peaks represents the sound pressure every time the engine fired. The smaller peaks are other sound sources, such as the prop, venturi, etc.

Figure 6 shows an O.S. .48 Surpass 4-stroke engine running at a slightly lower speed than the 2-stroke in figure 5. Notice that it fired twice in the same amount of time as indicated by the peaks. Remember, 4-strokes fire once every two revolutions of the prop. Also notice that the height of each peak was greater than that of the 2-stroke. Indeed, the peak dB produced by the 4-stroke was considerably higher than that of the 2-stroke, but since both dB meters and our ears are averaging devices, the average dB worked out to be identical, 94dB at 9 feet, in both cases. Since the 4-stroke was producing fewer peak pulses, its sound is perceived as being of a lower frequency, which makes us believe it operates at a lower volume.

In any case, the lower-frequency noise is generally more acceptable to our ears—and those of our neighbors—but is not necessarily less harmful.

THE SEARCH FOR QUIET

Editor's note: the authors' video, "Model Engines Volume 1," was favorably reviewed by Jef Raskin in our May '93 issue. In the course of researching and filming that movie, the authors performed many tests with mufflers, after-mufflers, propellers and soft mounts in an effort to reduce engine noise. The rest of Part 1 of this article summarizes the test results reported in the video.

We chose an O.S. .46 SF ABC, because it is a good example of current engine and muffler technology. In order to properly address the sound problem, we must separately address its two primary characteristics: frequency and volume.

We can lower the frequency of the sound our engines produce by lowering their rpm. We can do this by using a higher load factor prop that will slow the engine down.

The second characteristic of the sound—volume—is harder to address. Mufflers are the primary means of lowering the sound pressure of the exhaust; however, the mufflers provided with most engines are barely effective at this task.

We tested the engine without a muffler, with the stock muffler and a series of aftermarket mufflers, a tuned pipe and muffler add-ons commonly called after-mufflers. The results we obtained are shown in figure 7.

Our results showed that the sound reduction obtained with these devices varied, but in all cases was a bit disappointing. We did notice that a number of these actually

TYPE OF EXHAUST	dB	RPM
O.S. .46 SF ABC — 10x6 wood prop		
Unmuffled	117	15,600
Stock muffler without baffle	98	14,500
Stock muffler with baffle	94	13,600
Lawnmower muffler	95	14,600
J'Tec Snuffler	95	14,600
Davis Soundmaster	95	14,600
MACS Quiet Pipe	100	15,400
After-mufflers added to stock muffler		
11 oz. fuel tank as after-muffler with 10, ⅛-inch holes	91	13,200
BP Products after-muffler	93	14,000
Hand -lotion bottle with 8, ⅛-inch holes	90	13,200

Figure 7

allowed engine rpm to increase over the stock muffler, indicating either a less restrictive exhaust or a tuning action similar to a tuned pipe.

A different approach was clearly needed. We decided to lower the engine rpm by increasing the propeller size. We repeated the tests with an 11x6 wood prop. Based on some prior data, we carefully balanced and rounded the tips of the prop. In separate tests, we had consistently seen sound reductions when using round-tip props instead of square ones. Some of the more significant results are presented in figure 8.

TYPE OF EXHAUST	dB	RPM
O.S. .46 SF ABC — 11x6 wood prop		
Stock muffler	89	12,000
Davis Soundmaster	92	12,700
BP Products after-muffler	88	11,800

Figure 8

TYPE OF MOUNT	dB	RPM
O.S. .46 SF ABC - stock muffler — 11x6 wood		
Standard "hard" mount	92	11,900
Sullivan #275 soft mount	90	11,500

Figure 9

So far, our tests had shown the stock muffler to be nearly as effective as the after-market products. The major sound reduction occurred when we slowed the engine down by using a bigger prop. Since all of the tests to this point had been conducted on a test stand, we decided to check the sound level of the engine on a Sig Four-Star 40 to see if we could measure an increase in sound levels

(Continued on page 115)

ROTORPLANE

(Continued from page 35)

"vintage" and ensures ground stability. The legs are made of bent 0.040 sheet aluminum and mounted with pan-head 4-40 screws and locknuts. The Du-Bro* 1.75-R wheels are mounted on 4-40 screw axles and retained by locknuts. The tail wheel isn't really '30s vintage, but it makes takeoffs smoother. The pilot's office is staffed by Pong, my long-suffering veteran test pilot. Note how the hatch is keyed into place and held at the front with a single wide rubber band. The plastic fuel tank is a 35mm film container. It supplies plenty of fuel for a satisfying, long run of the Cox* Medallion engine, and I've never had one of these tanks leak! The vent is to the air; no engine pressurization is needed.

ROTOR

The rotor is made in two sections that are joined by a 1/8-inch music wire axle that runs in a brass-tube bearing. Study the plan before you start to build. The rotor is a basic end-capped flat-plate rotor with trailing-edge stock edges for "lead-in slope." Starter hooks initiate rotation. I use 1/16-inch hard-balsa end plates, but lite-ply would be a better choice. To minimize interference from propeller wash, inboard plates are faired out with shallow typing-paper cones.

Correct alignment is important; the axle must turn freely. I lubed the bearing with Tri-Flow—a super-greasy Teflon® aerosol. After 50 flights, I was convinced that ball bearings would have been a waste of time. A single 3-48 screw, a nut and a locking washer are used to mount the rotor on its pylon. The balance point should be around two-thirds of a rotor diameter in front of the rotor axis. The swing mount makes it easy to adjust the rotor for optimum flight. (Raising or lowering the rotor axis when the rotor is swung to different positions has no perceptible effect on flight.)

I bent, machined and drilled my engine mount out of 1/8-inch heat-treated aluminum, but I recommend that you buy a ready-made fiberglass one.

ENGINE

A good engine installation is essential. My vintage Cox .09 exhaust-throttle Medallion engine was supplied by Skip Ruff, and after a rehab trip to Cox's Don Hatcher, it works well. With a Cox black nylon 7x3.5 prop, it's just right for the Rotorplane!

I use a 2-channel Futaba* radio with two

(Continued on page 80)

ROTORPLANE

(Continued from page 78)

S133 microservos, and a 4-cell, 270mAh battery pack. With one channel on throttle and one on rudder, I enjoy good control of the model. Set the engine up to run full-bore with the throttle stick centered.

FLYING

The Rotorplane! should be flown "ROG" in calm or light wind. The takeoff roll will be about 30 to 50 feet. The climb-out is at a realistic, scale-like rate. (With a quiet engine you can hear the rotor "wow-wowing.") Keep turns gentle until you get the hang of it. It goes up when you open the throttle and descends when you close it. With the rudder hard over, the Rotorplane! will spiral downward just like a fixed-wing plane. Sharp S-turns quickly kill altitude, but recovery is quick with a flip of opposite rudder.

Keep mental tabs on how much fuel you have. If you run out of fuel at altitude, the plane will simply autorotate to the ground. The landing won't be hard enough to do any damage, but it will hardly be elegant, and it won't be a fitting end to an otherwise impressive performance. Make your landings under power: estimate sink rate to your spot, and ease off throttle all the way down.

This rotor-plane design is just a start; many avenues remain unexplored. Good flying!

Here are the addresses of the companies mentioned in this article:
Du-Bro Products, *480 Bonner Rd., Wauconda, IL 60084.*
Cox Hobbies, *350 W. Rincon St., Corona, CA 91720.*
Futaba Corp. of America, *4 Studebaker, Irvine, CA 92718.* ■

PROPELLER

(Continued from page 55)

we don't know how a propeller performs at any given airspeed (and if a wind tunnel isn't readily available to find out), we have to choose propellers based on static testing (easy to do), or the "change it and fly it" method (easy to do, but very subjective, due to many variables other than the change in prop, i.e., wind, weather, battery condition, etc.). However, it becomes less important to know *which* propeller is better than another if you fly and fly and fly the heck out of the propeller you have already chosen. Practice makes perfect, and as you now can see, its not just how well the airplane flies that's important, but that you learn to *fly* the propeller as well (manage its forward speed by varying the climb rate).

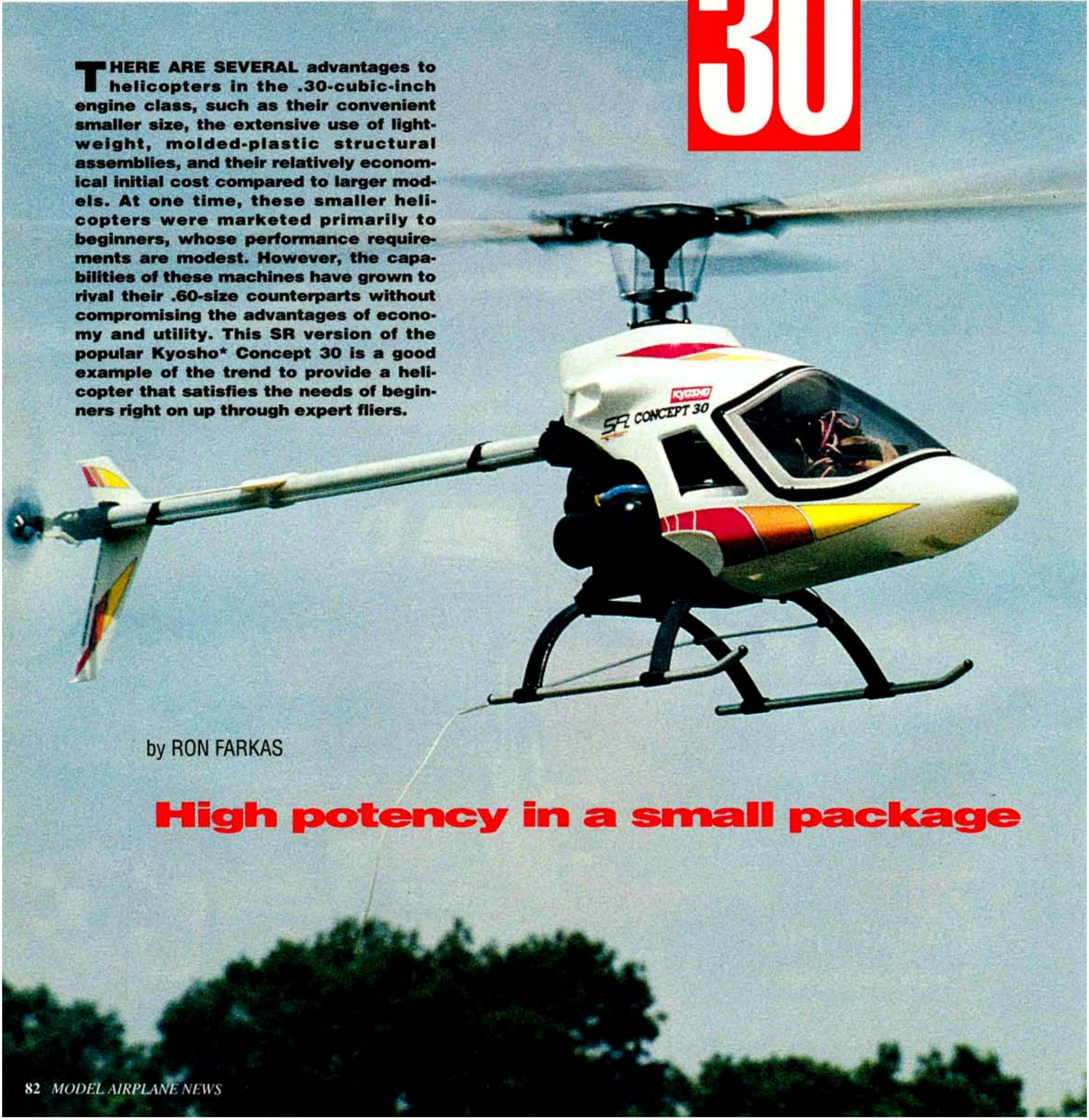
Many of you will never get the opportunity to do any sort of testing in a wind tunnel. However, with the general performance trends I have shown here, maybe you will be

(Continued on page 94)

KYOSHO

Concept 30 SR

THERE ARE SEVERAL advantages to helicopters in the .30-cubic-inch engine class, such as their convenient smaller size, the extensive use of lightweight, molded-plastic structural assemblies, and their relatively economical initial cost compared to larger models. At one time, these smaller helicopters were marketed primarily to beginners, whose performance requirements are modest. However, the capabilities of these machines have grown to rival their .60-size counterparts without compromising the advantages of economy and utility. This SR version of the popular Kyosho* Concept 30 is a good example of the trend to provide a helicopter that satisfies the needs of beginners right on up through expert fliers.

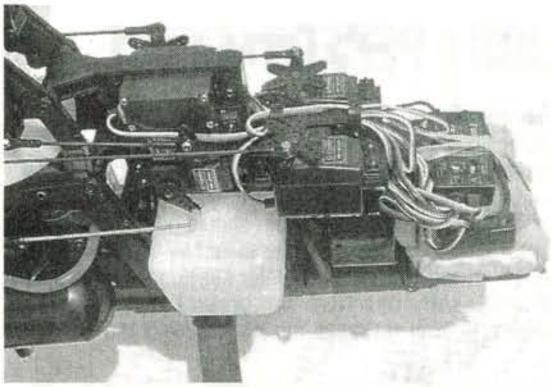


by RON FARKAS

High potency in a small package

SOME HISTORY

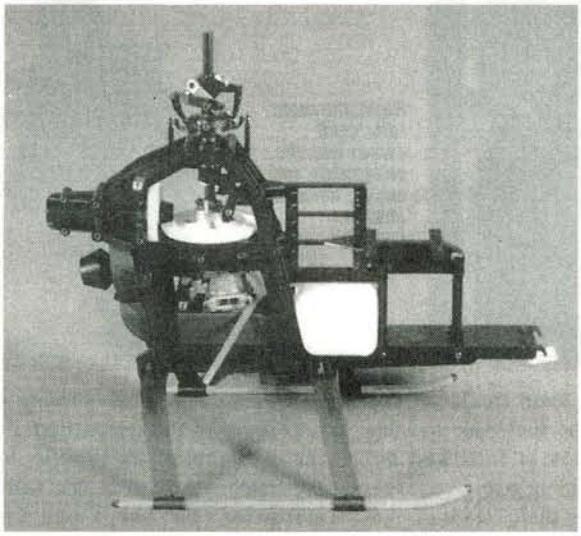
When first introduced, the original Concept 30 DX achieved immediate popularity owing to its innovative mechanical arrangement and rotor-head design, which provided operational simplicity and very good flight stability for ease of learning. The upgraded SE version was a bit more responsive for intermediate level fliers, and the follow-on SX version was even more aerobatic for the advanced pilots, particularly hot-doggers. The next generation SR version, reviewed here, has additional high-performance features, but retains the successful mechanical gear train layout and rotor head design of its predecessors. Kyosho has taken the approach of increasing stability through the rotor-head geometry, while also increasing responsiveness through greater control travel and better precision in the linkages.The Concept 30 SR has a metal (instead of plastic) washout mixing base and levers for less free play, new metal pivot balls for smoother operation and longer wear, reinforced molded rotor-head components and robust one-piece main blade holders with dual radial bearings and thrust bearings. The SR blades are longer and weighted, for both higher top speed and better autorotation performance. Structural improvements include stronger, more rigid servo mounts, and longer, stiffer landing gear. A greater total collective pitch range of 24 degrees assures enough positive and negative travel for aerobatics, although it won't all be used for training or sport flying.



Forward frame showing radio installation.

ASSEMBLY

Kyosho has always been a leader in producing graphically illustrated instruction manuals, featuring numbered assembly steps with exploded views that are accompanied by some brief test. Full-size sketches of the required loose hardware items are also included. Elsewhere in the booklet, all parts are cross-referenced by key number, description, bag number, step number and spare parts pack number. This approach is quite effective at showing how the parts fit together and in what sequence they should be assembled. However, I feel that the customer should be given extra advice on some of the more critical procedures. For example, I damaged the plastic tail-rotor pitch plate because the instructions did not indicate that its brass bushing was reverse-threaded. Fortunately, a nice fellow on the Tower Hobbies helicopter hotline agreed to provide a complimentary replacement.



Completed helicopter main frame has the motor, gears and rotor shaft already installed. Inverted engine location is unique to Concept helicopters.

PHOTOS BY RON FARKAS

The manual also had a few minor discrepancies in the hardware callouts. For example, the first step—flybar installation—illustrates an M4x5 (that's 4x5mm) setscrew, while only an M3x4 fits and is supplied. Generally, it's that easy to spot mistakes, especially if you've sorted all of the different screw sizes into an egg carton or muffin tray.

The assembly sequence must be followed quite precisely. The rotor head is to be built in five steps until it is ready to place on the main shaft. The shaft already had the mixing levers, pitch slider and swashplate installed—a big time saver. After adding the main drive gear onto the shaft, that entire subassembly is put aside until the joining of the two side frames. The servo tray and the engine subassemblies must also be prepared in advance.

THE POWER UNIT

The engine, mount, clutch, fan and shroud go together to form a conveniently removable power system. A helicopter engine of .30 to .35cid is required, and for this review, Great Planes provided an O.S.*.32H. The kit included a handy, deep-socket tool for tightening the fan nut. Unfortunately, even the SR model

SPECIFICATIONS

Model name: Concept 30 SR helicopter
Manufacturer: Kyosho; distributed by Great Planes Distributors
Rotor diameter: 47.25 in.
Blade style: Symmetrical section, wood construction, weighted
Weight: 5.5 lbs.
Length: 40.6 in.
Engine size: .30 through .35
Sug. retail price: $569.95 (Tower Hobbies)

Features: intelligent use of high-strength plastic components in frame and rotor head; modular engine installation with rear cone start; easy construction and control set up; pictorial instruction booklet.

Hits:
- Convenient size and economical price range
- Popular upgrades included as standard parts
- Docile and forgiving flight characteristics for beginners and sport pilots
- Agile and responsive flight characteristics for advanced and hot-dog pilots
- Easy to maintain and repair

Misses:
- Instruction booklet could use more explanations to accompany the drawings

FLIGHT PERFORMANCE

• Hovering

The hover is stable, with good control authority and predictable response. The initial control settings enabled hovering within the range of the transmitter trims. Thus, with careful building, a beginner should get off to a good start. Once the engine's needle valve has been set properly for a moderate hovering rotor speed, the Concept 30 SR will gently rise from the ground without being twitchy. Control response for maneuvering and for atti-

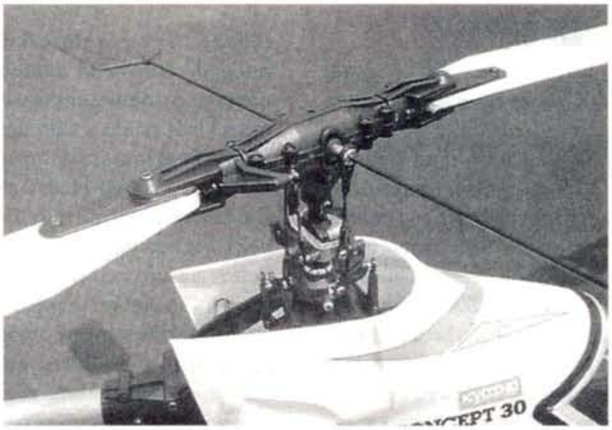
tude correction is positive, yet well-damped. It is relatively easy to hold constant altitude, position and heading. Being small and light, it is somewhat sensitive to gusty wind conditions, but outstanding for its class. Overall, it will build confidence in beginners and enable the more competent flyers to feel relaxed.

• Flying Circuits

The rotor-head design and its geometry produce stable and groovy forward flight. There is very little of the unwanted pitch-up tendency that is occasionally present in some helicopters. The machine tracks well, staying on heading with the tail properly following the nose. Top speed can vary from moderate to quite rapid, depending on the power available and rotor head rpm. The O.S. .32H is more than adequate, and it really comes alive with the optional Helimax* tuned pipe. Use of the initial blade pitch setting and just moderate control throws produces a comfortable range of speed and maneuverability for pilots who are progressing to forward flight. However, the low-pitch setting of zero degrees should be reduced to about minus two degrees once the pilot is ready for a steeper descent when returning from forward flight into a hover.

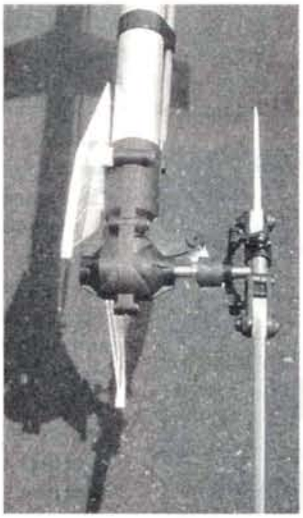
• Flying Aerobatics

When set up with extremes of pitch and control travel and using a hot engine, it appears that the Concept 30 SR has unlimited aerobatic capabilities. I have seen them flown forward, backward and sideways, while right-side up or upside-down. Hot-dog maneuvers include such weird things as backward loops and rolls, inverted backward figure eights and stationary flips to inverted and back upright. While the exceptionally skilled pilots make it all look too easy, what it means to the advancing pilot is that the machine will be capable whenever you are ready to try something new. Another advantage is that if you have good reflexes, you can safely bail out of a maneuver that isn't going well. Although, in general, a .30-size helicopter lacks the mass and inertia for utmost smoothness and precision, this model's mechanical design and its weighted blades seem to offset that disadvantage very well. For example, autorotations are particularly good, with lots of reserve energy for the landing.



Completed rotor head showing all linkages.

still comes with the original plastic starter cone instead of the longer-lasting aluminum accessory part. When the side frames are joined, they capture the engine module,



Left: tail rotor showing pitch change linkage.

Right: the main rotor shaft comes with the swashplate and mixing linkages already installed.

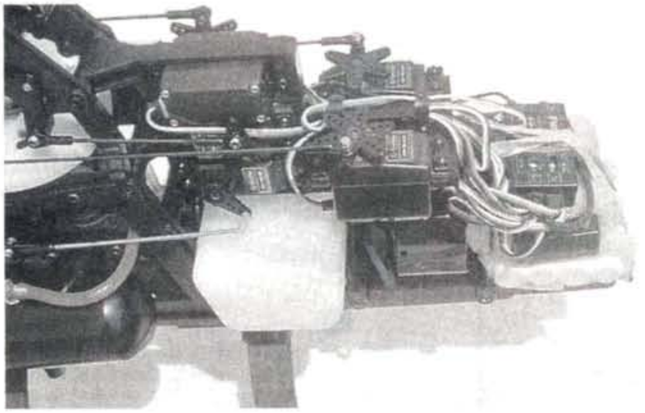
along with the main shaft, the tail counter gear, the fuel tank and the servo tray. This is followed by installing the landing gear.

The tail rotor shaft, bearings and pitch slider must be assembled prior to fitting the gears and installing the unit within the tail gearbox. Note that the plastic pitch plate is screwed onto the slide bushing with a left-hand thread, although not indicated in the instructions. Installation of the tail boom to the frame readies the machine for radio installation. For this project, I used an early version of the Futaba* 7-UHP helicopter system (now referred to as the Super Seven). The Concept's molded plastic trays will accommodate any average-size servos. For helicopter service, dual-ball bearing servos are preferable; mine are Futaba S5101. I am using the economical single-rate Futaba G154 gyro. The control rods were installed according to the instructions, with the exception of the throttle. Since the frame was right in line with the carburetor's ball link, I used a piece of after-market threaded rod with a couple of bends for clearance.

After a few weekends of practice, I had gotten accustomed to flying inverted circuits and did my first outside loops. What a thrill.

FINAL SET-UP HINTS

Unfortunately, the instructions lack specific reference to servo-arm length or control-rod travel distance, which would be of benefit to the newcomer. The illustrations show the use of the outermost holes in what must be assumed to be standard-size servo wheels. There is an informative guide for setting up the Futaba Super Seven transmitter, but



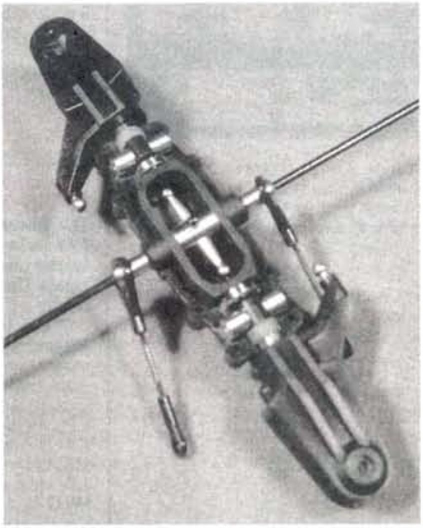
The Concept's molded plastic trays will accommodate any average size servo.

it does not determine the actual control sensitivity. The included punch-out, craft-paper, main-blade pitch gauge does, however, provide an excellent range of settings for a beginner. Experienced pilots will set up the linkage to their own preferences. For example, I adjusted the mechanical linkages for extreme throw and used the programmable radio to initially obtain moderate control travel and pitch curve. The remainder will be used for aerobatics. I am using minus seven to plus nine degrees of collective pitch for switchless inverted.

Being quick and agile, this model is somewhat better suited to freestyle aerobatics than precision hovering maneuvers.

AT THE FLYING FIELD

Hover trimming was routine, except for a rather sticky tail-rotor pitch-control linkage. Judging by past experience, this is uncommon on Concept 30 helicopters. I eventually traced the problem to tight ball links at the tail rotor blade holders, which still use integrally molded pivot balls. For a simple solution, I used an old trick of placing a metal ball into the plastic clevis and lightly squeezing with pliers. This leaves a slight depression in the interior of the clevis and thus reduces friction. It proved to be a complete cure, and the testing was resumed with flying circuits and then progressed to aerobatics.



Partially assembled rotor head. Note the flybar seesaw linkage and the individual blade axles.

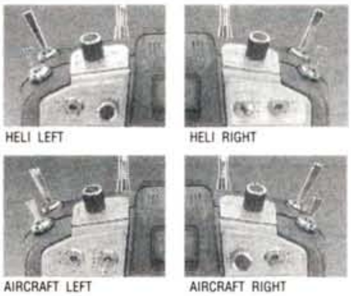
I was eager to try many of the maneuvers that I'd seen performed at demonstrations by topnotch hot-dog pilots and factory fliers. I had already flown some switchless inverted on another helicopter (rest its soul), so it was onward and upward with the Concept 30 SR, and over onto its back. Not only was the helicopter very responsive, but it was also stable and predictable. After a few weekends of practice, I had gotten accustomed to flying inverted circuits and did my first outside loops. What a thrill. Being quick and agile, this model is somewhat better suited to freestyle aerobatics than precision hovering maneuvers. On the other hand, in spite of its small size, it is also one of the most docile and forgiving helicopters for learning and sport flying. Because of its mechanical design features and high-quality parts, the Kyosho Concept 30 SR is about as close as you can get to an all-purpose helicopter.

**Here are the addresses of the manufacturers mentioned in this article:*
***Kyosho**; distributed by Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826.*
***O.S.**; distributed by Great Planes Model Distributors.*
***Futaba Corp. of America**, 4 Studebaker, Irvine, CA 92713.*
***Helimax**; distributed by Great Planes Model Distributors.* ■

NEW HELI PRODUCTS

JR
JR X-388S Heli Radio System

This radio is an advanced version of the X-347. The X-388S heli is one of three different X-388S transmitters. It has switches and knobs positioned and defined with helicopter control in mind, giving its user the most convenient operation possible. It also has the internal software of the X-388S glider and airplane transmitters to permit operation of those model types. The 388S heli version has a balanced, ergonomic radio case, eight channels, eight model memory and powerful programming options: stunt trim, hold rudder, etc. The S-series PCM processing in the X-388S produces ultra-precise 1024 servo resolution and industry-leading servo response time. It's also sold with JR's new 649S receiver. The smallest, lightest 9-channel receiver made, the 649S includes a new version of their ABC&W™ circuitry, which assures glitch-free model operation on all channels.



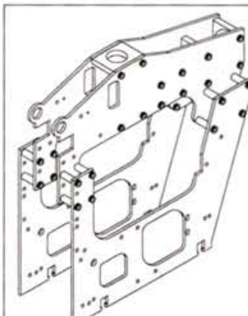
Price: $609.95 to $1,049.95 (depending on servos and modulation).
Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-0022.

GREAT PLANES
Kyosho Zeal Gyro

The Zeal Gyro has two independently set levels of gyro control with a 6-channel heli radio. Fliers can set one level for greater sensitivity to "lock-down" the tail during hovering, and set the other for less sensitivity and more tail control during aerobatics. Because of a special, light flywheel design, it's 30 percent lighter than many other comparable gyros, yet it maintains the momentum of heavier models. It's especially suited to .30-size (and smaller) helis. Specifications: current draw—60mAh; power source—4.8V to 6V common power supply; amp section—1.5x1.1x0.4 inches; gyro—1.6x1.4x1.3 inches; gain controller—1.3x1.0x0.5 inches.

Part no. KYOM1190
Price: $159.99
Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826; (217) 398-6300.

HEL-X CORPORATION
Composite Side Frame System



This Hirobo Shuttle upgrade is made of a military-grade composite material that provides superior strength and helps damp vibration. The side-frame system includes all the bearing blocks, boom-mounting blocks, spacers and screws needed for assembly. Its design allows your Shuttle to be stripped down and reassembled with all of its original parts on the composite side frames. It's intended for engine sizes with .28 to .46 cid, and all Shuttle SE Gold upgrades are compatible with it.

Part no. A5050
Price: $129
Hel-x Corporation, 558 Highland Ave., Upper Montclair, NJ 07043; (201) 744-4962.

Descriptions of new products appearing on this page were derived from press releases supplied by the manufacturers and/or their advertising agencies. The information given here does not constitute an endorsement by **Model Airplane News**, nor guarantee product performance or safety.

by JEF RASKIN

10TH ANNIVERSARY GREATER SOUTHWEST FAN FLY

Subject: *the title tells it all.*
Source: *Telstar Video Productions Inc., 1501 S. Decker Ave., Ste. 109, Stuart, FL 34994; (800) 972-4847 or (407) 671-6144.*
Summary: *exciting models to watch, interesting information on ducted fans.*
***List price*:** *$24.95 (plus $3.25 S&H).*
***Approximate length*:** *88 minutes.*

This tape is a treat, not only for its display of over an hour of great ducted-fan flying, but also for its gracious spirit and helpful presentation.

I still tend to think of ducted fans as being new kids on the block, but this event has now been going on for a decade. Dozens of fans flocked to Lockhart, TX, which is near Austin, to see these sophisticated, handsome, intricately detailed models. The ducted fans not only look deceptively realistic, but they fly and taxi like their big brethren as well. I'll admit that I usually don't like "big," and I am not partial to jets, but this tape made me want to run right out and get a ducted-fan unit and build something fast around it. It's contagious.

Narrated by CD Rich Shafer, this video leaves you with the feeling that you've been there. It concentrates on the exciting moments, lots of fine takeoffs and well-taped landings. Each pilot and builder is briefly presented, and their names appear on the screen (a practice every video should follow). The few crashes are spectacular.

If the products used in building fan jets interest you, you will appreciate that the names and addresses of the people making and selling the products are given in an "advertising" segment at the end. I think that this is a very good idea: stacking the ads at the end doesn't interrupt the flow of the video, and the advertisers can take the time to display addresses, show products, and give detailed information.

Along with the flying, there are a few interviews, for example, one with 10-year-old contestant Daniel Ligon, who flies a MiG 15, and another with Top Gun second-place flier and Best of Show at Toledo builder Jerry Caudle. His plane, whose airframe alone took 600 hours to build, flies at 180mph. A servo opens the canopy (though not, I hope, at 180mph!). We barely see a low pass of one of the planes at 218mph. This segment doesn't take long. If all this isn't enough, the tape also features a full-scale flyby and one of the best R/C helicopter aerobatic routines I have yet seen on video. If you like ducted fans or jets, or are willing to risk being sucked into this phase of our hobby, buy this tape and run it through your VCR. You'll like what comes out on the screen.

WRING IT OUT, VOLUME III

Subject: *how to fly hot-dog aerobatics.*
Source: *Carl Goldberg Models Inc.*
Summary: *fancy flying for the advanced aerobatic pilot; very well presented.*
***List price*:** *$29.99.*
***Length*:** *52 minutes.*

Having seen Volumes I and II of this series, I have been looking forward to the release of Volume III

(Continued on page 115)

PROPELLER

(Continued from page 80)

able to narrow your choices of propellers a bit for your next venture into the sprint electric competition. This may save you a little money and possibly a lot of time. Till we talk again!

**Here are the addresses of the companies mentioned in this article:*
Astro Flight Inc., *13311 Beach Ave., Marina Del Ray, CA 90292.*
Normark Electronics, *1710 E. 78th St., Minneapolis, MN 55423.*
Master Airscrew; *distributed by Windsor Propeller Co., 3219 Monier Cir., Rancho Cordova, CA 95742.*
Aeronaut; *distributed by Hobby Lobby Intl., 5614 Franklin Pike Cir., Brentwood, TN 37027.*
Sonic Tronics Inc., *7865 Mill Rd., Elkins Park, PA 19117.*
Zinger; *distributed J&Z, 25029 S. Vermont Ave., Harbor City, CA 90710.* ■

FOAM CUTTER

(Continued from page 58)

inch of the work surface; make sure there is clearance for the balance weights. Check the direction on the "point" wheel; it should move the bow towards the side with the longer cut. Failure to do this results in the bow's moving sideways, causing the pull-cord clip to rub against the template.

CUTTING DIFFERENT FOAMS

Dow PRB foam is recommended in the manual. Don't knock yourself out trying to find this foam unless you are in an area where stucco is commonly used in buildings. You just won't find it in the East (unless you want to buy enough foam for a lifetime). The Feather Cut works equally well on blue Dow Styrofoam, Dow Greyboard, pink Foamular 150 and various densities of white-bead foam. As you gain experience with the cutter, you will fine-tune the temperature and weight location to optimize the cutting speed. The biggest improvements in core quality over hand cutting comes when you cut dense foams like the blue Styrofoam.

If you are looking for a high-quality foam cutter, consider the Feather Cut. It is capable of producing quality cores, and its use can be mastered quickly. The setup and operation is simple and only requires one person. When not in use, it stores conveniently and takes a minimum of space in the workshop. The Feather Cut is a good investment for clubs or prolific builders.

**Here are the addresses of the manufacturers mentioned in this article:*
Tekoa: The Center of Design, *3219 Canyon Lake Dr., Hollywood, CA 90068; (213) 469-5584.*
Weston Aerodesign, *944 Placid Ct., Arnold, MD 21012; (301) 757-5199.*
LJM Associates, *1300 N. Bay Ridge Rd., Appleton, WI 54915-2854; (414) 731-4848.* ■

ROBART

(Continued from page 61)

electronic spark advance. Both of these ignition systems will be available as extras from Robart. The welded, steel-tube engine mount with rubber soft-mount points comes with the engine, and it's meant to solve any mounting problems. Out of the box, it's easy to mount the engine on the firewall.

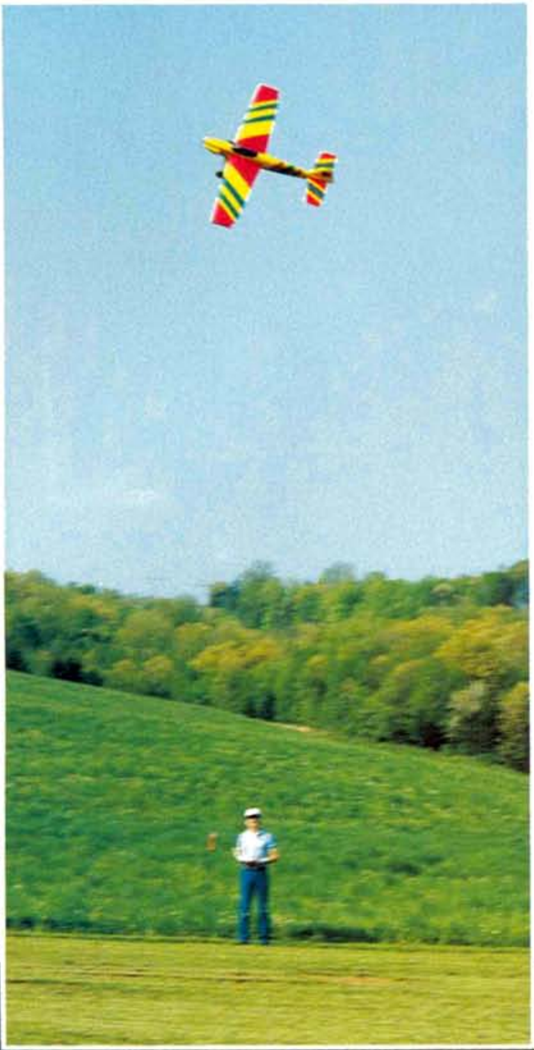
Considering its $9\frac{13}{16}$-inch outside diameter, the engine will fit into many different models now on the market—as long as they have the proper ground clearance for that 26-inch-diameter prop!

The selling price for the first run of engines will be $3,500 for the glow version and $4,000 for the spark-ignition version. The price will go up after each production run. Whether you plan to put your Robart radial in a glass case, or run it in a scale round-nose warbird as Bob intended, it's

(Continued on page 104)

MODEL AIRPLANE NEWS MAGAZINE
FIELD & BENCH REVIEW

by DAVE MILLER



DAVE BARON, PILOT

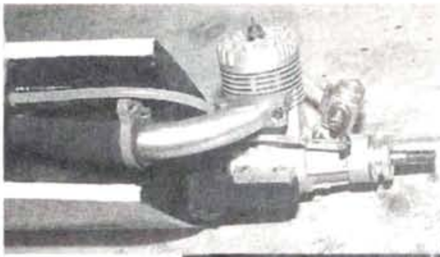
HOBBY LOBBY

Romeo

I'VE BEEN building R/C aircraft for six years, but until now, they've all been U.S.-made, so I was very pleased when *Model Airplane News* invited me to build and review a new German model. Designed and manufactured by Modell and distributed here by Hobby Lobby*, the Romeo sounded like a challenge.

The kit's package showed detailed photos and gave information on the Romeo's construction and intended flight envelope. All the parts were neatly packaged, and the exceptionally good balsa and flawless lite-ply immediately caught my eye. (It's better than any I've used.) The parts were numbered, and my overall impression was that this kit would be a breeze to construct. And then I looked at the plans and the instructions....

A clean design with hideaway exhaust



The engine—in this case an RJL .61—is mounted at a 45-degree angle so that the tuned pipe lines up in the ventral channel. Motors generally have a much more reliable idle in this position than in the 90-degree inverted position.

The plans are quite good. The lines on the three, fine, highly detailed sheets are crisp and clear. Page 1 shows an invaluable exploded view of the completed aircraft; pages 2 and 3 show the fuselage and wing and tail assemblies. The words on the drawings are, however, all German. "No problem," I thought. "I'll read the instructions." Five comprehensive pages (no photos) give orderly construction steps, beginning with the fuse and tail assemblies and going on to the wing. Although the instructions are in English, I spent a considerable time deciphering "lingo," e.g., "schwerpunkt" means CG, etc. The instructions are at times overstated, which is often the case when translating technical data from German to English. This "phenomenon" can sometimes make a simple job seem more complex than it really is.

This hideaway channel not only gives the Romeo a very clean appearance, but it may also provide a sound-deadening effect.

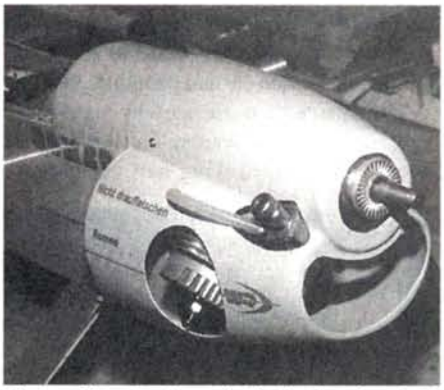
The hardware package includes all the screws, washers, cables, bellcranks, etc., you need to complete the plane, and everything is of the highest quality.

With all my previous building projects, I just seemed to jump in and build, but with this kit, I had to think ahead—not because the kit is more difficult to build, but because the instructions are different from those most of us are used to.

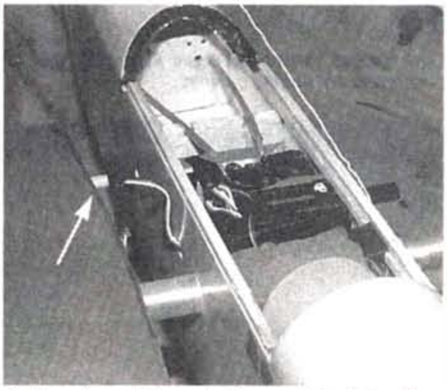
CONSTRUCTION

Using simple techniques, the fuselage is made of built-up lite-ply. The sides are in one piece, and the bottom is in three parts that are assembled in such a way that they make a "channel" for your exhaust header and muffler. This is a clean design, and I think it also helps to reduce noise. In operation, the fuselage has shown itself to be strong enough to take rough landings and a cartwheel on occasion.

The turtle deck and the front fuel-tank



The cowl is not only aesthetically pleasing, but it also seems to deliver sufficient airflow for good cooling.



PHOTOS BY TOM ATWOOD AND DAVE MILLER

As the wings slide onto the mounting tube, they also key into the fuselage side through an alignment-peg (note arrow) in the wing root.

FLIGHT PERFORMANCE

• Takeoff and landing

With its low, wide stance, the Romeo is a very easy tail-dragger to manage during taxiing, takeoffs and landing roll-outs. Only slight rudder control inputs are necessary owing to its long tail moment. If short takeoffs are required—or just your "thing"—the Romeo is up to the job.

• High-speed handling

It's very stable in gusty conditions. The Romeo maintains its heading well, even in the wind. Though it did snap in tight loops, this was caused by too much elevator throw. Control adjustment corrected the problem. The aircraft did not require trim changes at different throttle settings; it tracks very well, and its clean, appealing form offers outstanding penetration.

• Low-speed performance

In a word, excellent! Low-speed stalls usually cause the nose to drop straight ahead. This is followed by a flat recovery and fly-out after it has regained air speed. No trim adjustments are necessary when changing from high to low speed. Low speeds require minimal elevator back-pressure. The Romeo's high aspect ratio produces long glides with positive lateral control at all times. Its low drag does give it a slight tendency to over-shoot on still days. Though this model has excellent glide and stall characteristics, you can push things too far, especially in gusting ground winds. It's best to keep a little throttle at hand, because a wingtip can drop—especially if the gust it's riding suddenly dies!

• Aerobatics

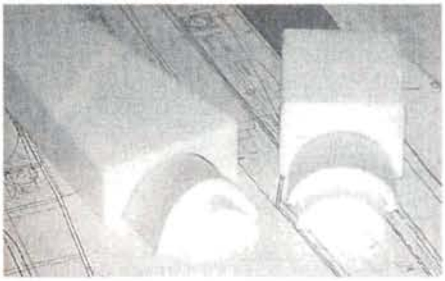
The plane performs good axial rolls and clean snaps. The Romeo tracks through beautiful inside and outside loops, but don't expect fun-fly diameters from a design like this. With its 0-degree incidence and center-line mounted wing, the Romeo tracks well in all attitudes, including knife-edge flight. Overall, this high-aspect-ratio design really lends itself to large, graceful aerobatics. Because it's durable and has fixed gear, the groovy-looking Romeo is a great choice for Sunday sport fliers who want to hone their pattern skills.

cover are unique. They're made of molded Styrofoam covered with thin obechi wood—easy and quick to do. The cockpit and the canopy fit between these two parts, and the joint is accurate.

The wing is constructed in halves. Each half is attached to the fuselage by slipping it over an aluminum tube and securing it with a bolt. Aligning pins are located at the rear of the root rib. Most of the wood is balsa, but the innermost ribs and wing-bolt plates are plywood and hardwoods. Start with the ribs and the hardwood spar, then install the leading and trailing edges, the leading and trailing balsa planking and the rib caps. After making the wing halves, cut out the ailerons, plank the aileron leading edge and wing trailing edge with balsa, sand, and set aside for final assembly. I had to add a support between each rib and planking, though.

The ailerons are operated by a push-pull bellcrank and rod system. I elected to use one servo for each wing half because it's

The Romeo comes packaged very well, and all materials are of high quality.

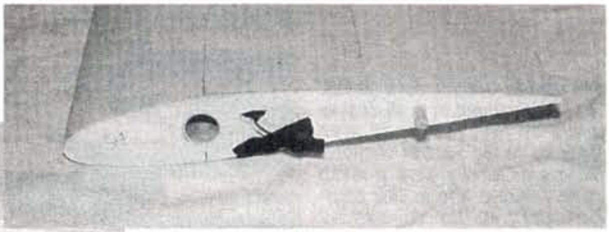


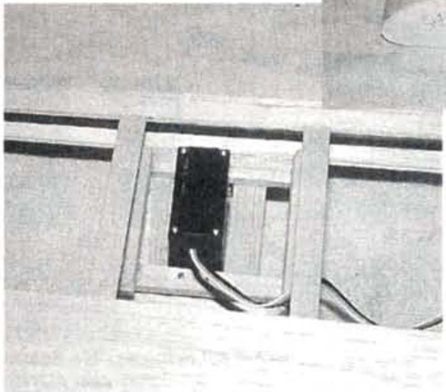
The fuselage-top components are prefabricated assemblies of cut foam and obechi.

what I'm used to. The aircraft accepted these changes very well.

The fin, rudder and horizontal stabs are built up with balsa, tapered by sanding, and then sheeted. (The high-quality tail-feather parts are numbered.) The elevators are of solid balsa.

The strong aluminum landing gear is bent





The Romeo is a natural for a two-servo aileron system conversion. These two photos tell the story better than words.

for you at the factory. It seems to absorb shock very well, but it isn't so springy that it has the extra landing bounce that we all know so well.

POWER

Choose your favorite engine mount, bolt it to the firewall, and install your engine. That's it! Be extremely careful when aligning the exhaust stack through the landing-gear mount and into the exhaust cavity. With the help of Mac's Products*, I was able to obtain an almost perfect fit with an exhaust header, a rubber exhaust extension, and a round Graupner* muffler. (Most tuned pipes will fit in this cavity.)

The unique engine cowl is quite functional. It's large enough to allow you to vary the engine's position; it's easy to install on the fuselage; and it allows cool air to circulate around the engine. My experience led me to strengthen the inside of the cowl with a lining of fiberglass tape and epoxy. The plastic cowl seemed strong enough to withstand a certain amount of abuse, but for my own peace of mind, I gave it that extra support.

SPECIFICATIONS

Model name: Romeo
Distributor: Hobby Lobby (mfg.: Modell)
Type: sport
Sug. retail price: $129
Wingspan: 63 in.
Wing area: 570 sq in.
Weight: 7.5 lb.
Length: 49 in.
Motor/engine used: RJL .61 2-stroke
No. of channels req'd: 4 (aileron, elevator, rudder, throttle)
Prop used: 11x6
Radio used: Futaba 7UAP
Washout built into wing: yes
Airfoil type: NACA 2415
Wing construction: balsa
Kit construction: ply and balsa
Optional accessories used: none

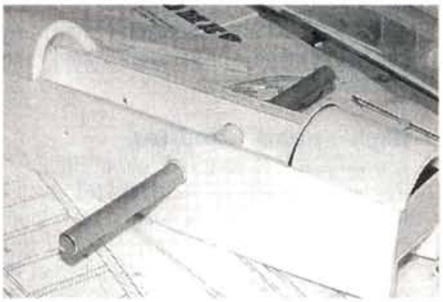
Features: all-wood construction, precision-cut balsa parts; preformed fuselage top; accurate and detailed plans; complete hardware package.

Hits
- Operates quietly owing to muffler channel in fuselage
- Large cowl is easy to work with
- Long, slow approaches
- Very stable in flight
- Exploded-view plans

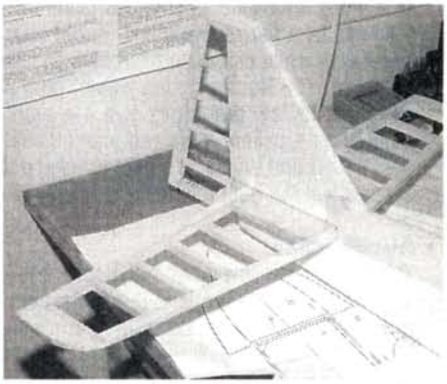
Misses
- Instructions not well-translated
- Plans labeled in German

ROMEO GOES UNDERCOVER

The cowl is painted, but the rest of the aircraft is covered with Hobby Lobby



The fuselage structure is strong with its plywood sides and aluminum wing-mounting tube.



The tail group is composed of ridged, built-up and sheeted components.

Oracover. Oracover, isn't difficult to apply, but I recommend that you read the instructions so that you'll understand how this covering works and why. It sticks to wood at low temperatures, but it can be peeled off and re-applied if you make a mistake. It's then heat-shrunk to make a very tight covering.

My covering is perfect—no wrinkles, seams, etc. In fact, at the field, a novice asked me if it was very hard to spray-paint a plane such as the Romeo! The German self-stick decals on the cowl and near the exhaust port give the Romeo a special finishing touch, and after many flights, they're still stuck fast.

POWER AND CONTROL

I use a Futaba* 7UAP 4-channel radio with five servos. Throttle, elevator, rudder, ailerons are the four channels used, with mixing for flaperons. There's more than enough room in the fuselage for the battery, the receiver and the servos.

My high-quality, U.S.-made, RJL* .61 2-stroke engine features Schnuerle porting, low vibration and good power. (I've seen the RJL .61 advertised at around $100. This has to be one of the best deals available.) I broke-in my engine with four, 8-ounce tanks of 5-percent-nitro fuel. It gives good response and provides enough power for an almost unlimited vertical climb.

After an adequate engine warm-up, the Romeo taxied out for its first flight. With full throttle and minimum right rudder, Romeo was flying in approximately 20 to 30 feet (see flight performance sidebar). While flying it, I have encountered every conceivable situation: high winds, updrafts while on final approach, dead-sticks and loss of power because of running with a fuel mixture that was too rich (all caused by pilot "tinker-itus").

I've neither pampered nor abused my Romeo. On every outing to the field, it has flown without fail, and it has survived many rough landings. It's by no means a beginners' plane, but it's fun to own, and you'll improve your pilot skills by flying it.

Here are the addresses of the companies mentioned in this article:
***Hobby Lobby Intl.**, 5614 Franklin Pike Cir., Brentwood, TN 37027.*
***Mac's Products**, 7935 Carlton Rd., Sacramento, CA 95826.*
***Graupner**; distributed by Hobby Lobby.*
***Futaba Corp. of America**, 4 Studebaker, Irvine, CA 92718.*
***RJL Enterprises**, P.O. Box 5, Siera Madre, CA 91025.* ■

ROBART

(Continued from page 94)

likely to become a well-sought-after piece of modeling history.

**Here are the names of the manufacturers mentioned in this article:*

Robart Mfg., *P.O. Box 1247, 625 N. 12th St., St. Charles, IL 60174.*

Sonic Tronics Inc., *7865 Mill Rd., Elkins Park, PA 19117.*

McDaniel R/C Inc., *1654 Crofton Blvd., Ste. 4, Crofton, MD 21114.*

ULTRA SPORT

(Continued from page 69)

ENGINE

For power up front, I used the SuperTigre 2500 engine. By the way, I placed a J'Tec* Snuffler muffler (which is recommended) on the engine. It performs well. I also used a J'Tec Snuff-Vibe isolated motor-mount system. This is a really simple mounting system that works well.

With everything installed and the systems checked out, I headed to the flying field for my first test flights. The final, finished weight of my aircraft was a paltry 12 pounds—a featherweight for an aircraft of this size. After I used the battery pack to shift the CG, balance was right on the money. I used a 5-cell, 1700mAh pack, which had punch to spare.

CONCLUSION

Overall, the US1000 is a real comer. Any sport-level pilot can make it fly, and expert pilots will feel like playing "Tournament of Champions" with it. It's easy to build, it handles well and it provides solid performance. It's a "no-sweat" model for the big bird enthusiast.

**Here are the addresses of the companies mentioned in this article:*

Great Planes Model Distributors, *P.O. Box 9021, Champaign, IL 61826.*

Hobbypoxy Products, *36 Pine St., Rockaway, NJ 07866.*

Satellite City, *P.O. Box 836, Simi, CA 93062.*

Top Flite Models; *distributed by Great Planes Model Distributors.*

Ace R/C Inc., *116 W. 19th St., Box 511C, Higginsville, MO 64037.*

RCD, *10729 Wheatlands Ave., Ste. C, Santee, CA 92071.*

Futaba Corp. of America, *4 Studebaker, Irvine, CA 92718.*

J'Tec, *164 School St., Daly City, CA 94014.*

ENGINE NOISE

(Continued from page 77)

owing to the airframe. Much to our surprise, the sound level of the engine with the stock muffler and the 11x6 rounded-tip wood prop jumped a full 3dB when we installed it on the model! This seemed like a good opportunity to test the effectiveness of soft mounts. The video's sound section concluded with this test and its results are shown in figure 9.

Our quietest setup on the airplane at that time was the stock muffler, rubber soft mounts and the 11x6 rounded-tip wood prop. Even with all of these measures, we only succeeded in dropping the dB at 9 feet to 90 from the original 94 of the stock configuration. This was sufficient to meet the AMA's 90dB at 9 feet guideline, but we were not convinced that this was as good as it could be. In Part 2, we will describe further steps taken to reduce noise, and conclusions reached, based upon our field tests.

Editors note: increasing the prop load to slow engine rpm usually results in some rise in engine temperature. If the propeller is too large, the heat generated can exceed the tolerances of the lubricating oil, thereby damaging the engine. This can be a concern, for example, during prolonged periods of idling on the ground, where airflow can be inadequate for cooling. The recommendations presented here should not cause concern. The authors point out that most modern glow engines, unlike their antecedents of only a few years ago, can handle slight overpropping safely.

The tendency for heat build-up could be alleviated by changing the engine's timing and compression ratio and increasing the size of the cooling fins. Manufacturers are currently trying to compromise between torque and horsepower to meet the largest sales market. As engine noise becomes more of an issue, market demand for quieter engines will grow. ■

VIDEO VIEWS

(Continued from page 93)

with anticipation. I was not disappointed, nor will you be. Dave Patrick, who flies with a grace and precision that we would all do well to emulate (or at least envy), defines hot-dogging as "flying with perceived risk." For example, flying a 360-degree turn inverted at an altitude of 200 feet may be an example of precision flying; flying the same thing at an altitude of 2 feet is hot-dogging because we wait with trepidation for the ground to rise up and smite the model. A flat spin is more of a hot-dog maneuver than an ordinary spin, since we've all heard of the many pilots who have crashed when they failed to get out of one. This knowledge adds the edge of excitement that hot-doggers crave. Then there are maneuvers so spectacular that they are "hot-dogging" at any altitude, such as a knife-edge loop, and we are shown a number of these crowd-pleasers. Patrick explains the ins and outs of flying in the hot-dog style, while the video simultaneously shows both the plane in flight and just how the sticks are manipulated. With practice, the risk has largely gone, but the perception of risk remains.

While the flying is the main attraction, the tape also presents information on the landing of large ignition and glow engines, battery maintenance and smoke systems.

Using a $^1/_3$-scale Extra 300, a Goldberg Ultimate and Patrick's own Finesse 120 FAI pattern plane, he demonstrates in detail how to fly (take a deep breath) the flat spin, inverted flat spin, knife-edge spin, outside snap into an inverted spin, takeoff to knife-edge, reverse knife-edge, knife-edge snap, knife-edge circle, knife-edge loop, four-point stall turn, 270-degree stall turn, vertical snap roll, reverse snaps, snap-roll on takeoff, the rolling circle, tail slide, tail-over-nose tumble and low loop. He also demonstrates a takeoff into a stall turn (hammerhead) that leads to an immediate landing in the direction opposite to the takeoff. I may have missed one or two items in this list, but you get the idea: there is a lot of information in this tape, but it's never so dense that it gets dull. Even the ending credits are spiced with some truly funny outtakes.

A hint is given in the dialogue that there may be a Volume IV some day. Let's hope so. In the meanwhile, enjoy the first three. ■

Product News

YELLOW AIRCRAFT

P-47 Thunderbolt

This new, improved version of the P-47D Thunderbolt is available as a Bubble Canopy or a Razorback. It has an 80-inch wingspan, and it can be powered by engines ranging from a Super Tigre 3000 to a G-62. The kit includes many fiberglass parts: a highly detailed fuselage and cowl, all control surfaces, wingtips, a canopy frame, gear doors, an antenna, a bellypan and a cockpit tub. The wing and the stab are made of pre-sheeted foam. The gear mounts are installed and the servo wells are routed.

Prices: $390 (Razorback); $375 (Bubble Canopy).

Yellow Aircraft, 203 Massachusetts Ave., Lexington, MA 02173; (617) 674-2222.

BEEFSTEAK MINES LTD.

"Model Sailplanes without Myth or Magic"

This book explains in simple terms the hows and whys of model sailplanes and presents basic theory and design factors that concern all sailplane enthusiasts. Look for these topics: How does the glider fly? Do you really know how to launch? Is your airfoil sophisticated enough? What does the horizontal tail really do? The book has three illustrations, no equations and no diagrams—just 170 pages of straight information.

Price: $18.95 (plus $3 S&H).

Beefsteak Mines Ltd., P.O. Box 1645, Jackson, WY 83001; (307) 733-3729.

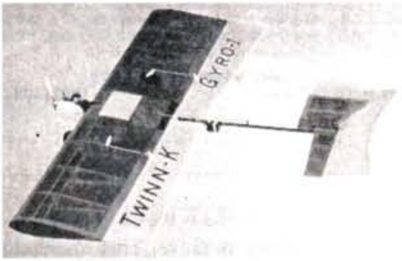
JOMAR

Gear Door Cycler

The Gear Door Cycler is for aircraft—such as the P-51 Mustang—that have split gear doors with one half hinged to the wing. Each time the retract lever is operated up or down, the Gear Door Cycler opens the gear door; it waits for 1 to 9 seconds, and then it automatically closes the doors. Use a Y-harness to install the small electronic unit in parallel with your retract servo. You'll have to install your own radio leads. The tiny $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$-inch unit weighs only $\frac{6}{10}$ ounce.

Price: $39.95

Jomar, 3440 Riverhills Dr., Cincinnati, OH 45244; (513) 271-3903.



TWINN-K

Gyro-1

Twinn-K's first model aircraft kit is the Gyro-1 fun-fly plane. Its one-piece wing design simplifies building and creates a very stable wing. It has continuous 48-inch spars, conventional building materials, excellent maneuverability, spectacular slow-speed turning, superb aerodynamics, wing loads of 7.5 to 8.5 ounces/square foot and large control surfaces with no flutter. With a .25- to .40-size motor, its in-flight characteristics make it easy to have fun at any speed. All the necessary hardware and fiberglass standoffs are included.

Price: $79.95

Twinn-K Inc., 4770 W. 139th St., Cleveland, OH 44135; (216) 433-1988.

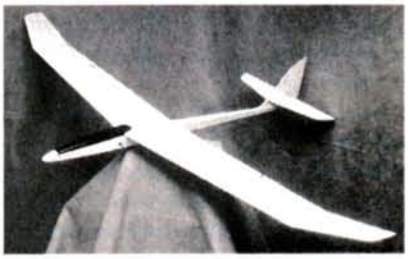
TALON PRODUCTS

Fastener Kits

These fastener kits will be a welcome addition to your workbench. They combine more than 300 pieces of the highest-quality, most popular standard- or metric-size socket-head cap screws, nylon insert locknuts and washers. A high-impact, clear plastic, sectional case keeps everything in order.

Price: $21.95

Talon Products, P.O. Box 91, Crystal Lake, IL 60039; (815) 455-7177.



NORTHEAST SAILPLANE PRODUCTS

Alcyone 2M

Like its big brother, the Alcyone 2M has ailerons and coupled rudder, elevator and flaps. It uses three servos and doesn't require a computer radio. The wing loading is low for a high-performance two-meter design, and this contributes to its outstanding sink-rate performance. The modified Schuemann planform, SD7032/SD7037 airfoil combination and turned-up tiplets provide quick, easy response and a surprisingly flat glide. The one-piece foam wing has a carbon-fiber-reinforced spar. The fuselage is constructed of plywood, balsa and spruce. Specifications: wingspan–78.75 inches; wing area–609 square inches; weight–35 ounces.

Price: $99.95

NorthEast Sailplane Products, 16 Kirby Ln., Williston, VT 05495; (802) 658-9482.

PRODUCT NEWS

PROCTOR ENTERPRISES
DeHavilland Tiger Moth

Proctor Enterprises announces the addition of this kit to its fine line of scale vintage aircraft. The kit has a high degree of prefabrication to decrease building time; fiberglass top decking, complete with anti-spin drakes and full surface detail; a fiberglass cowl; a scale fuel tank; vacuformed pilot seats; windscreens; a scale oil tank; interplane strut endcaps; cabane strut fittings; and die-cut balsa and plywood wing and tailplane ribs. All decals and instrument dials are included.

Part no. 1600

Price: $524.95

Proctor Enterprises, 25450 NE Eilers Rd., Aurora, OR 97002; (503) 567-1300.

MODEL AVIATION TECHNOLOGY
AC-DC Charger and ESV Voltmeter

Model Aviation Technology introduces the AC-DC Charger and the ESV Voltmeter. The AC-DC Charger charges at the rate of 400mA and, to prevent an overcharge, it goes into automatic trickle when the batteries are fully charged. With the provided plug, it can be used with any 12V battery at the field or from your car. The ESV Voltmeter provides instant voltage readings under a 300mA load, and lights indicate the battery's condition—no more guesswork! It reads transmitter voltage and 4.8 Ni-Cd-receiver battery voltage.

Prices: $49 (AC-DC Charger); $25 (ESV Voltmeter).

Model Aviation Technology, 12848 Touchstone Pl., Palm Beach Gardens, FL 33418; (407) 626-6955.

JET HANGAR HOBBIES
SBD-Dauntless

This limited-production kit has die-cut parts, balsa wing sheeting, foam wing cores, flaps, dive brakes, a retractable tail hook, an operating bomb yoke, a sliding canopy, a scale cowl with a dummy engine, a molded 1,000-pound bomb and plans for building twin, .30-caliber machine guns. The kit also contains a pilot's instrument panel and gauges and parts to build a machine-gunner's chair. Fully illustrated plans, an in-depth instruction booklet and a 3-view are also provided. Specifications: wingspan–64 inches; wing area–780 square inches; fuselage length–51 inches; designed for .60 to .90 engine.

Price: $269.95

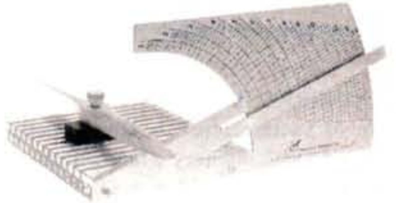
Jet Hangar Hobbies Scale Model Suppliers, 12130G Carson, Hawaiian Gardens, CA 90716; (213) 429-1244.

AEROTREND
Hold-Vac

The Hold-Vac is a self-contained suction tool that helps you place decals and other small parts that have non-porous surfaces. It replaces tweezers for many applications, and it will not scratch or damage your plane's parts. It fits in your pocket like a pen, and it doesn't need batteries. Four probes with different size suction cups are included: one ¼-inch, one ⅜-inch and two ⅛-inch.

Price: $19.99

Aerotrend, 31 Nichols St., Ansonia, CT 06401-1106; (203) 734-0600.



PRATHER PRODUCTS
Prop Pitch Gauge

This pitch gauge works on props that are up to 12 inches in diameter and have 3 to 15 inches of pitch. It allows you to true both prop blades and change their pitch so that you can get the maximum performance out of the prop and engine. Complete instructions are included.

Part no. 7050

Price: $59.95

Prather Products Inc., 1660 Ravenna Ave., Wilmington, CA 90744; (310) 835-4764.

DAVE BROWN PRODUCTS
Straybilizer

The easy-to-use Straybilizer—a one-piece, solid-wire accessory for your transmitter—performs two functions. First, it's a transmitter tray, and using your neck strap leaves your hands free to work the controls. It's also a stand that holds the transmitter at an angle so that it's easy to use all the controls. Covered with a protective non-slip coating, the Straybilizer also helps to keep dust and dirt out of your transmitter.

Part no. TRAY-2450

Price: $9.95

Dave Brown Products Inc., 4560 Layhigh Rd., Hamilton, OH 45013; (513) 738-1576.

Descriptions of products appearing in these pages were derived from press releases by the manufacturers and/or their advertising agencies. The information given here does not constitute endorsement by **Model Airplane News**, nor guarantee product performance. When writing to the manufacturer about any product described here, be sure to mention that you read about it in **Model Airplane News**.

NAME THAT PLANE

CAN YOU IDENTIFY THIS AIRCRAFT?

If so, send your answer to *Model Airplane News*, **Name That Plane Contest** (state issue in which plane appeared), 251 Danbury Rd., Wilton, CT 06897.

CONGRATULATIONS TO SMS/Ret. Rex Williams Jr. of Sacramento, CA, for correctly identifying the April 1993 mystery plane. The Northrop C-125 (YC-125A) Raider was developed from the Northrop N-23 Pioneer, a 40-passenger commercial transport powered by three 596 kW (800hp) R-957 Cyclone engines. The 23 C-125 Raiders that were built for the USAF were each powered by three 894 kW (1,200hp) Wright R-1820-99 engines. Of these 23, 13 were designated for assault transport (C-125A) and 10 were designated as Arctic rescue aircraft (C-125B).

The Raider was a mechanic's dream because its airframe was very easy to access, and it had many very large, easy-to-remove inspection panels and doors. Engine cowls were hinged so they could be swung out of the way by hand, and special tools weren't required to open the aircraft. The C-125's sturdy, fixed, main landing gear was designed to absorb the heavy loads associated with rough field operations. The wheels could be removed and replaced without jacking up the landing gear. When the aircraft was expected to land on soft ground, an additional wheel could be fitted to each axle to provide a wider footprint to help distribute weight. Northrop licensed Canadair Ltd. in Montreal, Canada, to produce the Raider for the world market. Rex trained on YC-125 Raiders at Sheppard AFB Aircraft Maintenance School in 1953. ■

The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. Mail), and will receive a free one-year subscription to **Model Airplane News.** If already a subscriber, the winner will receive a free one-year extension of his subscription.

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